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THE PHILIPPINE
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SCREENING OF PHILIPPINE HIGHER PLANTS FOR ANTIBACTERIAL SUBSTANCES

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TWO PLATES

Since the discovery of penicillin as a "Wonder Drug" in the treatment of diseases, a world-wide search for new sources of antibiotics has been provoked. In this search, higher plants, which as far back as 4,000 B. C. (10) have been known to have contributed much in the treatment of human diseases, have not been overlooked as possible sources of these substances. Painstaking researches have been undertaken by several investigators to screen them for antibiotics usually against the gram-positive *Micrococcus aureus* Zopf. and gram-negative *Escherichia coli* (Migula) Castellani and Chalmers, and occasionally against acid-fast organisms, fungi and protozoa. George and Pandalai (7) and George, et al. (8) in their preliminary surveys of important Indian medicinal plants for antibacterial activity, reported that many of these plants contained substances antagonistic to *M. aureus* and *E. coli*. They also studied the relative capacity of different solvents in extracting the active principles and the relation of changes of seasons to the antibiotic contents and their distribution in different parts of the plants. Bishop and MacDonald (2) investigated 209 Nova Scotian plants and reported that 33.4 per cent of them exhibited antagonistic reaction to *M. aureus* and *E. coli*. Almost the same percentage of antibacterial activity was obtained in their subsequent studies of 177 more plants (12).

Sanders, et al. (15) examined 120 plant species from Monroe County, Indiana, and found that one-tenth of them produced positive signs of bacterial inhibition when tested against either or both *Bacillus subtilis* (Cohn) Praznowski and *E. coli.* Gottshall, et al. (9) found that 27 out of 161 species of plants examined by them were active against *Mycobacterium tuberculosis,* strain H37, but that most if not all of the antibacterial properties were lost when whole blood was added to the test medium. Carlson and Douglas (4) found that the use of various solvents on 300 species of plants in one case and on 550 species in another case brought out the presence of several active agents, which inhibited *M. aureus* and *E. coli* and which diffused in varying degrees on the seeded agar. Burlage, et al. (3) screened toxic plants for their antibacterial effects and found that most of them showed some measure of bacterial inhibition.

The above review indicates positively the presence of antibacterial substances in higher forms of plant life and the wide distribution of these forms in nature. The existence of such plants in the Philippines is assumed, considering its rich flora which, according to an estimate, may consist of more than 10,000 species, of which approximately 8,000 are already known. Of this number 858 species have been enumerated and discussed by Quisumbing (14) as medicinal, 63 species being recognized in various pharmacopœias. In addition to this investigator, Marañon and Tuason (13), Sulit (17), and Valenzuela, et al. (18) have also contributed much to our recent knowledge on local medicinal plants.

This paper deals with the screening not only of medicinal plants but also of any higher plants, indigenous to or introduced in the Philippines, for the presence of antibacterial substances capable of inhibiting the growth of the test organisms, *M. aureus* and *E. coli.*

MATERIALS

Three hundred twenty-nine species of plants collected from the different localities in the Philippines were used in this investigation. These plants were examined while still fresh and when this could not be done the specimens were kept in a refrigerator. Each plant before being tested was identified according to families, genera and species. In the examination of medicinal plants, the parts commonly used for medication were preferred.

METHODS

Preparation of the extracts.—Only clean healthy plants or parts of the plants were used. The material selected was chopped into small pieces and then two 5-gram samples were weighed. Extraction of the antibacterial substance was done as follows: The 5-gram sample was pounded in a mortar. A little of the solvent (95 per cent ethyl alcohol or distilled water) from a measured volume of 20 cc was added and the mixture washed and then transferred into a 125-cc Erlenmeyer flask. The rest of the solvent was added by flooding the mortar with it and then pouring the washing into the same flask. The flask was corked and the mixture was allowed to stand with occasional shaking for 24 hours. The extract was filtered into a test tube and used immediately in testing for the presence of an antibacterial substance.

Test for antibacterial substance by the modified filter paper-disc agar plate method.—In this investigation, *E. coli* obtained from the Institute of Hygiene, University of the Philippines, through the courtesy of Dr. Potenciano Aragon, and *M. aureus,* one of the organisms in the stock collection of the Institute of Science and Technology, were used as the test organisms.

The test plate was prepared by pouring 10 cc of nutrient agar* with the aid of sterile pipette into a sterile 90-millimeter Petri dish. The agar in the disc was evenly distributed and then allowed to solidify on a level surface. Four cubic centimeters of seeded nutrient agar, prepared by suspending two cubic centimeters of the test organism from a 24-hour broth culture in 100 cc melted nutrient agar at 45 to 48°C, was evenly distributed on the surface of the solidified agar in the dish. The seeded dish was incubated at 37°C for 45 minutes before the test was performed.

The filter paper discs, 13.5 mm in diameter, were made by cutting Schleicher and Schull No. 589 filter paper with a cork borer. They were wrapped with clean paper in lots of four pieces, autoclaved for 30 minutes at 15 pounds pressure and then dried in the oven for one hour at 100°C.

The test for the antibacterial substance in the plant extract was done as follows: The sterile filter paper disc was grasped with a fine pointed pair of forceps and immersed into the test

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* The nutrient broth and agar used in this study were prepared according to the formula of Schmidt and Moyer (16).

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plant extract in the test tube. The excess liquid was allowed to drain by allowing the lower edge of the disc to touch the side of the tube. Three of such discs were prepared and carefully placed on the surface of the seeded agar in such a way that each of the three discs laid in the center of the three quadrants. A fourth disc wet with the same solvent used in preparing the extract was placed as a control in the middle of the fourth quadrant. To distinguish the control disc from those dipped in the extract, the outer surface of the Petri dish under the control disc was marked "C" with a glass pencil. The test plate was incubated at 37°C for 18 to 20 hours.

Extracts possessing antibacterial properties produced halo zones around the discs (Plate 1, figs. 1 to 4). Those possessing mild antibacterial properties showed inhibition under the discs. The diameter of the zone of inhibition was measured to the nearest 0.25 mm by means of a celluloid millimeter rule and with the aid of a magnifying glass. Complete, partial or slight inhibition within the halo zone, was determined under a stereoscope.

RESULTS AND DISCUSSIONS

The results of the screening of 329 plants for antibacterial substances are presented in Table 1. A close inspection of this table shows that many Philippine plants are a good source of antibacterial substances. Of the 401 alcoholic extracts tested against *M. aureus*, 58 showed complete inhibition; 20, partial; 29, slight; and 249, none. The inhibitory effects of those extracts on *E. coli* were shown to be complete by 4, partial by 19, slight by 28 and negative by 350. The aqueous extracts showed complete inhibition of *M. aureus* in 115, partial in 151, slight in 67, and none in 68. Against *E. coli*, 30 showed complete inhibition; 118, partial; 110, slight; and 143, none.

From the results obtained, it may be deduced that the antibacterial principles are more soluble in water than in alcohol. In cases in which they are extractable in either solvent, the alcoholic extract usually forms broader zone of inhibition of *M. aureus* than the aqueous extract. The reverse was observed when both extracts were tested against *E. coli*. It can also be shown that antagonistic extracts, whether alcoholic or aqueous, are more inhibitory to *M. aureus* than to *E. coli*.

TABLE 1.—*Results of antibacterial tests.*[a]

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
PTERIDACEAE:						
Pteris biaurita L.		Whole plant	0	0	*13.5	*13.5
POLYPODIACEAE:						
Athyrium esculentum (Retz.) Copel.	Pako	Leaves	0	0	*13.5	0
Drynaria quercifolia (Bory) J. Smith	Paipai-amo	Leaves	0	0	***22.5	*13.5
Pityrogramma calomelanos (L.) Link	Elecho	Leaves	0	0	***24.0	0
Pyrrosia adnascens (Sw.) Ching		Leaves	0	0	***14.0	0
CYCADACEAE:						
Cycas rhumphii Miq.		Leaves	0	*13.5	**13.5	**13.5
PINACEAE:						
Agathis philippinensis Warb.	Almaciga	Leaves	*13.5	0	***13.5	0
GNETACEAE:						
Gnetum gnemon L.	Bago	Leaves	0	0	***21.7	***17.0
PANDANACEAE:						
Pandanus odoratissimus L.	Pandan mabango	Leaves	0	0	*13.5	*13.5
		Roots	0	0	***13.5	0
Pandanus tectorius Solander	Pandan	Stem	0	0	0	0
GRAMINEAE:						
Andropogon citratus DC.	Tanglad	Leaves	0	0	***17.0	0
Bambusa vulgaris Schrad.	Kawáyan-kiling	Leaves	0	0	**13.5	**13.5
Imperata cylindrica (L.) Bauv. var. Koenigi	Cogon	Roots	0	0	***17.0	*13.5
Oryza sativa L.	Palay	Leaves	0	*13.5	**13.5	**13.5
Saccharum officinarium	Tubo	Leaves	0	0	***17.8	***15.5
Saccharum spontaneum L.	Talahib	Leaves	0	0	**13.5	*13.5
CYPERACEAE:						
Cyperus flabelliformis L.		Leaves	0	0	**13.5	**13.5
PALMAE:						
Areca catechu L.	Bunga	Leaves	0	0	***13.5	*13.5
		Bark	0	0	0	0
		Nuts	***19.1	0	***17.3	0
		Roots	0	0	0	*13.5
Chrysalidocarpus lutesceus Wendl.	Palmera	Leaves	0	0	**13.5	*13.5
Cocos nucifera L.	Niog	Bark	0	0	**13.5	0
		Roots	0	0	***13.5	**13.5
ARACEAE:						
Alocasia indica (Roxb.) Schott.	Biga	Leaves	0	0	***14.0	***13.5
Amorphophallus campanulatus (Roxb.) Blume	Pungapong	Leaves	0	0	***23.3	***13.5
Caladium bicolor (Ait.) Vent.	Corazon de María.	Leaves	0	0	***19.3	**14

[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter of the halo zone in mm.

[b] The system of classification is patterned after that of Engler and Prantl.

TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
Colocasia esculenta (L.) Schott. and Engl.	Gabi	Leaves	0	0	**13.5	**13.5
Rhaphidophora merrillii Engl.	Tabatib	Leaves	0	0	0	0
Typhonium divaricatum (L.) Decne.	Gabi-gabihan	Leaves	0	0	**13.5	**13.5
BROMELIACEAE:						
Dendropogon usneoides L.	Bohok ni Ester	Leaves	*13.5	0	***21.0	*13.5
COMMELINACEAE:						
Rheo discolor (L'Herit) Hance	Morado	Leaves	0	*13.5	*13.5	**13.5
Zebrina pendula Schinzl	Wandering Jew	Leaves	0	**13.5	**13.5	**13.5
LILIACEAE:						
Allium ascalonicum L.	Sibuyas Tagalog	Bulb	0	0	0	0
Allium cepa L.	Sibuyas Bombay	Bulb	0	0	0	0
Allium sativum L.	Bauang	Bulb	**33	***18	**29	***22
Asparagus officinalis L.	Asparagus	Whole plant	0	0	***34	**14
Cordyline fruticosa (L.) A. Chev.	Baston de San Jose	Leaves	0	0	**13.5	**13.5
Sansevieria zeylanica Wild, var. *laurenti*	Bowstring hemp	Leaves	0	0	**19	0
Smilax china L.	Sarsaparilla	Stem	0	0	*13,5	0
MARYLLIDACEAE:						
Agave Cantula Roxb.	Maguey	Leaves	0	0	***13.5	***14
Amaryllis belladonna L.	Dos-amante	Leaves	0	0	***18.5	**13.5
Crinum latifolium L.	Lirio	Leaves	0	0	***19.3	*16
Eurycles amboinensis L.	Katungal	Leaves	0	0	***15.2	0
DIOSCORACEAE:						
Dioscoracea alata L.	Ubi	Leaves	0	0	**13.5	***19.5
MUSACEAE:						
Musa sapientum L.	Saging	Leaves	0	0	0	*13.5
		Stalk	0	0	**13.5	**13.5
		Skin	0	0	*13.5	**13.5
Musa textilis Nee	Abaca	Leaves	0	0	0	**13.5
ZINGIBERACEAE:						
Costus clemensae Ridl.		Leaves	0	0	0	0
Costus sericeus Blume.	Tubang-usa	Leaves	0	0	***13.5	***13.5
Hedychium coronarium Koenig	Kamia	Leaves	0	**13.5	***13.5	**13.5
Zingiber zerumbet (L). Sm.	Luiang-usiu	Leaves	0	0	0	**13.5
CANNACEAE:						
Canna indica L.	Tikas	Leaves	0	0	*15	0
MARANTACEAE:						
Maranta arundinacea Blanco	Araru	Leaves	0	0	**13.5	**13.5
ORCHIDACEAE:						
Vanilla planifolia Ait. apud Naves Novis.	Vanilla (Commercial)	Leaves	0	0	**13.5	0
		Fruit	0	0	**14.0	*13.5

[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter; of the halo zone in mm.

[b] The system of classification is patterned after that of Engler and Prantl.

TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
Scientific name	Local name	Part examined	*M. aureus*	*E. coli*	*M. aureus*	*E. coli*
CASUARINACEAE:						
Casuarina equisetifolia L.	Agoho	Bark	***17.5	0	***17.0	*13.5
PIPERACEAE:						
Peperomia pellucida (L.) HBK	Ulasiman-bato	Leaves	0	0	**13.5	*13.5
Piper betle L.	Ikmo	Leaves	*13.5	0	*13.5	0
Piper loheri C.DC.	Paminta	Leaves	0	0	**13.5	0
Piper nigrum L.	Paminta	Leaves	0	0	**13.5	*13.5
Piper retrofractum Vahl.	Litlit	Leaves	***20.1	0	**14.0	***14.0
ULMACEAE:						
Aphananthe philippinensis Planch.	Alasiis	Leaves	0	**13.5	**13.5	**13.5
Celtis luzonica Warb.	Magabuyo	Leaves	**13.5	0	**13.5	0
Trema orientalis L.	Anabiong	Bark	0	0	**13.5	**13.5
MORACEAE:						
Artocarpus altilis (Parkins) Fosb.	Rimas	Leaves	*15.1	0	0	0
		Bark	***16.0	**13.5	***13.5	***13.5
		Roots	***20.0	0	*13.5	*13.5
		Flower	**13.5	0	***13.5	*13.5
		Fruit	0	0	**14.0	*13.5
Artocarpus blancoi (Elmer) Morr.	Antipolo	Bark	0	0	0	0
Artocarpus camansi Blanco	Kamansi	Bark	0	0	***15.0	*14.9
Artocarpus cumingiana	Anubing	Leaves	*13.5	0	*13.5	*13.5
Ficus elastica (Roxb.) Hort. Beng.	Rubber tree	Leaves	0	0	***17.0	*13.5
		Bark	0	0	**13.5	*13.5
Ficus hauili Blanco	Hauili	Leaves	0	0	*14.0	0
Ficus minahassae Miq.	Hagimit	Leaves	0	0	**13.5	**13.5
Ficus nota (Blanco) Morr.	Tibig	Leaves	0	0	*13.5	**13.5
Ficus stipulosa Miq.	Balete	Leaves	0	0	**13.5	**13.5
Ficus ulmifolia Lam.	Isis	Leaves	0	0	***28.0	0
		Fruits	0	0	0	*13.5
		Bark	0	0	*13.5	*13.5
		Roots	0	0	**13.5	0
Morus alba L.	Mulberry	Leaves	*13.5	0	**13.5	*13.5
URTICACEAE:						
Boehmeria nivea (L.) Gaudich.	Ramie	Leaves	0	0	***13.5	*13.5
Pilea microphylla Liebm.	Isang dakut na bigas	Leaves	0	0	*13.5	*13.5
Pipturus arborescens Link.	Dalunot	Leaves	0	0	**13.5	**13.5
OLACACEAE:						
Strombosia philippinensis (Baill.) Rolfe	Tamayuan	Leaves	*13.5	0	**13.5	**13.5
ARISTOLOCHIACEAE:						
Aristolochia tagala Cham.	Malaubi	Leaves	0	0	**13.5	**13.5
POLYGONACEAE:						
Coccoloba leptopus (Hook and Arn.) Stuntz.	Cadena de Amor	Leaves	0	0	**13.5	*13.5
Triplaris cumingiana Fisch and Mey	Palo Santo	Leaves	0	0	*13.5	0

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[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter of the halo zone in mm.

[b] The system of classification is patterned after that Engler and Prantl.

TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
CHENOPODIACEAE:						
Chenopodium ambrosioides L.	Alpasotis	Leaves	0	0	***17.0	*13.5
Muehlenbeckia platyclada Meism.	Alupihan	Leaves	0	0	0	0
AMARANTHACEAE:						
Achyranthes aspera L.	Hanggod	Leaves	0	0	***23.6	0
Aerua lanata (L.) Juss.	Apug-apugan	Flowers	0	**13.5	**13.5	**13.5
Alternanthera versicolor Hort.	Cucharita	Leaves	0	0	*13.5	*13.5
Amaranthus spinosus L.	Urai	Plant	0	0	*13.5	*13.5
Celosia argenthea L.	Kadayohan	Plant	0	0	***13.5	**13.5
Celosia cristata L.	Palong-manok	Leaves	0	0	**14.7	*13.5
Deeringia amaranthoides (Lam.) Merr.	Ditiran	Leaves	0	0	*13.5	**13.5
NYCTHAGINACEAE:						
Bougainvilla spectabilis Willd.	Bouganvilla	Leaves	0	0	**15.5	*13.5
Mirabilis jalapa L.	Alas cuatro	Leaves	0	0	***16.8	0
NYMPHAEACEAE:						
Limnocharis humboldti Rich.	Water poppy	Leaves	0	0	**13.5	*13.5
Nymphaea stellata Wild.	Water lily	Leaves	***19.1	0	**13.5	0
MENISPERMACEAE:						
Arcangelisia flava (L.) Merr.	Abutra	Bark	0	0	0	**13.5
Cissampelos pareira L.	Kalaad	Leaves	0	0	**13.5	**13.5
Tinospora reticulata Miers.	Makabuhay-puti	Leaves	0	*13.5	***13.5	**13.5
ANONACEAE:						
Anona squamosa L.	Atis	Leaves	0	0	0	0
		Bark	***15.0	***13.5	*13.5	***13.5
		Roots	0	0	*13.5	*13.5
		Fruit	*13.5	0	0	*13.5
Cananga odorata (Ham.) Hook f. and Thomas	Ilang-Ilang	Leaves	*13.5	*13.5	0	*13.5
Phaeanthus ebracteolatus (Presl) Merr.	Kalimatas	Leaves	*13.5	0	*13.5	0
LAURACEAE:						
Persea americana L.	Avocado	Bark	***16.0	0	***13.5	0
		Fruit	0	**13.5	**13.5	*13.5
		Leaves	0	0	0	0
		Roots	0	0	***18.0	0
CRUCIFERAE:						
Brassica chinensis	Pechay	Leaves	0	0	0	*13.5
Brassica oleracea L.	Repollo	Leaves	0	***13.5	***14.0	***13.5
Raphanus sativus L.	Labanus	Roots	*13.5	0	**13.5	**13.5
CAPPARIDACEAE:						
Cleome acutifolia Elm.		Plant	*13.5	0	***22.2	***23.6
Cleome spinosa Jacq.	Botete	Leaves	0	0	0	**13.5
		Stem	0	0	0	***13.5
Cleome viscosa L.	Silisilihan	Leaves	0	0	*13.5	**13.5

[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter of the halo zone in mm.

[b] The system of classification is patterned after that of Engler and Prantl.

TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
MORINGACEAE:						
Moringa oleifera Lam.	Malunggay	Leaves	***25.6	0	***20.3	**14
		Bark	*16.0	0	***16.0	*15.8
		Roots	0	0	***13.5	0
		Flowers	***29.0	0	***19.5	0
		Fruits	***22.5	0	**13.5	0
CRASSULACEAE:						
Sedum maxima Suter		Leaves	0	0	0	0
PITTOSPORACEAE:						
Pittosporum pentandrum (Blanco) Merr.	Mamalis	Leaves	0	0	***22.3	*13.5
ROSACEAE:						
Pygeum vulgare (Koehne) Merr.	Amoñgyong	Bark	0	0	**13.5	0
CONNARACEAE:						
Rourea erecta (Blanco) Merr.	Kamagsa	Leaves	***13.5	*13.5	**13.5	0
LEGUMINOSAE:						
Abrus precatorius L.	Saga	Leaves	0	0	**13.5	**13.5
Acacia confusa Merr.	Ayangili	Leaves	0	0	*13.5	0
Albizzia acle (Blanco) Merr.	Acle	Leaves	0	0	**13.5	0
		Bark	***15.3	0	**13.5	**13.5
Alysicarpus vaginalis L. DC.		Leaves	*13.5	0	**13.5	*13.5
Bauhinia malabarica Roxb.	Alibangbang	Leaves	**13.5	*13.5	*13.5	*13.5
Caesalpina crista Perk.	Kalumbibit	Leaves	***20.1	0	**13.5	0
Caesalpina sappan L.	Sapang	Bark	***16.5	0	*13.5	0
Cassia alata L.	Acapulco	Flowers	0	*13.5	*13.5	*13.5
		Leaves	0	0	0	0
Cassia bacillaris (L.) f.	Golden shower	Leaves	0	0	**13.5	**13.5
Cassia fistula L.	Fistula	Leaves	0	*13.5	**13.5	**13.5
Cassia sophera L.	Andadasi	Leaves	***20.0	0	**13.5	*13.5
Cassia tora L.	Balatong-aso	Leaves	0	0	***20.6	**13.5
Centrosema plumier (turp.) Benth		Leaves	0	0	***15.1	**14.0
Derris elliptica (Roxb.) Benth	Tubli	Leaves	0	0	***13.5	*13.5
Derris trifoliata Lour.	Silasila	Leaves	**13.5	**13.5	**13.5	**13.5
Desmodium pulchellum (L.) Benth.	Payang-payang.	Leaves	0	**13.5	*13.5	**13.5
Flemingia stroblifera (L.) R. Br.	Payang-payang	Leaves	0	0	*13.5	**13.5
Indigofera suffroticosa, Mill.	Tayum	Leaves	***21.0	0	**13.5	*13.5
Intsia bijuga (Colebr.) O. Kuntze.	Ipil	Leaves	0	**13.5	***20.1	**13.5
Leucaena glauca (L.) Benth.	Ipil-Ipil	Bark	0	0	**13.5	*13.5
		Leaves	0	0	**15.5	0
Mezoneurum latisiliquum, Cav. Merr.	Sapnit	Leaves	***13.5	0	**13.5	*13.5
		Pods	0	0	0	*13.5
Pachyrrhizus erosus (L.) Urb.	Sinkamas	Leaves	0	0	**13.5	0

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TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
Parkia javanica (Lam.) Merr.	Kupang	Leaves	**13.5	0	**13.5	*13.5
Parosella glandulosa (Blanco) Merr.	Kamangi	Leaves	0	0	**13.5	*13.5
Pithecolobium dulce (Roxb.) Benth	Kamatsili	Leaves	0	0	**13.5	0
		Bark	***20.1	0	***20.3	0
		Fruit	0	0	*13.5	*13.5
		Roots	***22.0	*13.5	***19.8	**13.5
Pterocarpus indicus Willd.	Narra	Leaves	0	0	**13.5	**13.5
Pterocarpus vidalianus Rolfe	Prickly narra	Leaves	0	*13.5	**13.5	**13.5
Samanea saman (Jacq.) Merr.	Acacia	Leaves	**14.7	0	***13.5	*13.5
Sesbania grandiflora (L.) Pers.	Katurai	Leaves	0	0	*13.5	**13.5
Vigna sinensis L.	Paayap	Leaves	0	0	**13.5	*13.5
Wallaceodendron celebicum, Koord.	Banuyo	Leaves	0	0	***13.5	** 13.5
OXALIDACEAE:						
Averrhoa bilimbi L.	Kamias	Leaves	0	0	***13.5	**14.0
Averrhoa carambola L.	Balimbing	Leaves	0	0	0	0
Biophytum sensitivum (L.) DC.	Makahiya-la-laki	Leaves	0	0	**13.5	0
RUTACEAE:						
Citrus grandis Osbeck	Suha	Bark	*15.5	0	***21.0	*17.0
Citrus nobilis Lour.	Dalanghita	Leaves	*13.5	**13.5	***17.1	**13.5
Citrus hystrix DC.	Kabuyan	Leaves	0	0	**17.0	0
Clausena anisum-olens (Blanco) Merr.	Kayumanis	Leaves	0	0	**13.5	**13.5
Melicope triphylla (Lam.) Merr.	Matang-araw	Leaves	0	0	*13.5	**13.5
Murraya paniculata (L.) Jack	Kamuning	Leaves	0	0	0	***18.0
BURSERACEAE:						
Canarium luzonicum (Blume) A. Gray	Pili	Bark	*13.5	0	*13.5	*13.5
MELIACEAE:						
Aglaia rimosa Lour.	Balubar	Fruits	**13.5	0	**13.5	*13.5
		Leaves	0	0	***13.5	**13.6
Dysoxylum decandrum (Blanco) Merr.	Agaru	Leaves	0	0	*13.5	0
Lansium domesticum Correa	Lanzones	Leaves	**14.6	0	0	0
Sandoricum koetjape (Burm.f.) Merr.	Santol	Leaves	0	0	0	0
		Bark	***15.0	0	***14.5	0
		Fruit	0	0	0	0
		Roots	0	0	0	*13.5
EUPHORBIACEAE:						
Acalypha amentacea Roxb.	Bagos	Leaves	**13.5	0	**13.5	*13.5
Acalypha indica L.	Maraotong	Leaves	**13.5	0	**13.5	0
Aleurites moluccana (L.) Willd.	Lumbang	Leaves	0	*13.5	***13.5	**13.5

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TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
Antidesma bunius (L.) Spreng.	Bignai.	Leaves	0	0	0	*13.5
		Fruit	0	0	0	0
		Bark	0	0	0	*13.5
		Roots	0	0	*13.5	*13.5
		Flowers	***13.5	*13.5	***13.5	**13.6
Antidesma ghaesembilla, Gaerthn.	Bignai	Leaves	0	0	**13.5	*13.5
Bredilia stipularis L. Blume	Hingongoto	Leaves	0	0	**13.5	**13.5
Coliacum variegatum L. Blume	San Francisco	Leaves	0	0	***21.6	*13.5
Euphorbia pilulifera L.	Botohotoni	Leaves	***14	0	***23.5	**13.5
Euphorbia nerifolia L.	Soro-soro	Leaves	0	0	***16.1	*13.5
Euphorbia pulcherrima Willd.	Pascuas	Leaves	0	0	0	0
Euphorbia splendens Boj.	Corona de espinas	Leaves	0	0	*13.5	**13.5
Fluggea virosa Roxb. Bail.	Boolan	Leaves	***22	**13.5	*13.5	*13.5
Glochidion philippicum, (Cav.) C.B. Rob.	Bagna	Leaves	*13.5	0	*13.5	**13.6
Homolanthus populens (Geisel.) Pax.		Leaves	***18.8	0	***14.5	*13.6
Homonoia riparia Lour.	Agoyoi	Bark	0	0	**13.5	**13.5
Macaranga tanarius	Binuñga	Leaves	***17.0	*13.5	0	*13.5
Mallotus philippensis (Lam.) Muell-arg.	Banato	Leaves	***18.0	*13.5	***13.5	**13.5
Mallotus ricinoides (Pers.) Muell-arg.	Hinlaumo	Leaves	***26.5	0	**13.5	0
Manihot esculenta Crantz.	Kamoteng kahoi	Leaves	0	0	*13.5	0
Melanolepis multiglandulosa, (Reinw.)	Alim	Leaves	***16.8	0	0	0
Pedilanthus tithymaloides L.	Luba	Leaves	0	0	***22.0	0
Phyllanthus niruri Blanco.	Sampa-sampalocan	Leaves	***20.1	0	***13.5	**13.5
		Bark	***15.2	0	***14.0	*13.5
ANACARDIACEAE:						
Buchanania arborescens, Blume	Balinghasai	Leaves	*13.5	*13.5	**13.6	**13.5
Mangifera indica L.	Mangga	Leaves	*13.6	0	0	*13.5
		Bark	0	0	**13.5	0
Spondias purpurea L.	Siniguwelas	Fruits	0	0	0	***13.5
		Bark	***16.0	0	***14.0	***13.5
		Leaves	***14.5	0	0	0
CELASTRACEAE:						
Eunymus javanicus Blume	Tabaan	Leaves	0	0	**14.0	***19.6
ICACINACEAE:						
Gonocaryum calleryanum, (Baill.) Bec.	Malatapai	Leaves	0	**13.5	***13.5	**13.6
SAPINDACEAE:						
Ganophyllum falcatum Blume	*Gugulangin*	Bark	***16.1	0	***18.2	0

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TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
Scientific name	Local name	Part examined	*M. aureus*	*E. coli*	*M. aureus*	*E. coli*
Harpullia arborea (Blume) Rdlk.	Uas	Leaves	**15.2	0	**13.5	**13.5
		Bark	0	0	**13.5	**13.5
Sapindus saponaria L.	Kosibeng	Leaves	0	0	**13.5	**13.5
BALSAMINACEAE:						
Impatiens balsamina L.	Kamantigi	Leaves	***13.5	0	*28.0	***13.5
RHAMNACEAE:						
Gouania javanica L.	Litiran	Leaves	0	0	**13.5	**13.5
VITACEAE:						
Cayratia trifolia (L.) Quis.	Kalit-kalit	Leaves	0	0	**13.5	***13.5
Tetrastigma harmandi Planch.	Ayo	Leaves	*13.5	0	0	0
Vitis vinifera, L.	Grape	Leaves	0	0	*13.5	0
TILIACEAE:						
Colona blancoi Merr.	Anilan	Leaves	0	0	*13.5	*13.5
Corchorus capsularis L.	Saluyot	Leaves	0	0	**13.5	*13.5
Muntigia calabura L.	Datiles	Leaves	***20.3	0	**13.5	*13.5
		Bark	0	0	*13.5	***13.5
		Fruits	***24.4	***20.1	0	*13.5
Truimfetta bartramia L.	Kulutkulutan	Leaves	0	0	**13.5	0
MALVACEAE:						
Gossypium sp. L.	Bulak	Leaves	***17.0	0	**13.5	0
		Bark	***15.0	0	**13.5	*13.5
Malachra capitata L.	Lapnis	Leaves	0	0	**13.5	*13.5
Malvastrum coromandelinum L. Garcke	Babara	Leaves	0	0	**13.5	*13.5
Malvaviscus grandiflora, L.		Leaves	0	0	***13.5	0
Sida acuta Burm. F.	Waliswalisan	Leaves	0	0	**13.5	*13.5
Sida javensis Cav.	Igat-igat	Leaves	0	0	***17.6	**13.5
Sida retusa L.	Escobang lukluk	Leaves	0	0	**13.5	**13.5
Sida rhombifolia L.	Ualis-haba	Leaves	0	0	**13.5	**13.5
Thespesia populnea L. Soland	Banago	Leaves	0	0	**13.5	0
Urena lobata L.	Kulotan	Leaves	0	0	**13.5	0
BOMBACEAE:						
Bombax ceiba L.	Malahulak	Bark	***15.6	0	**13.5	0
STERCULIACEAE:						
Kleinhobia hospita L.	Tan-ag	Leaves	0	0	**13.5	**13.5
Melochia umbellata Houtt.	Labayo	Leaves	0	0	***13.5	**13.5
Pterospermum obliquum Blanco	Kulatigan	Leaves	0	0	*13.5	0
		Bark	***15.4	0	**13.5	*13.5
Sterculia cuneata R. Br.	Malacacao	Leaves	0	0	**13.5	**13.5
Theobroma cacao L.	Cacao	Bark	0	0	***13.5	0
DILLENIACEAE:						
Dillenia indica (L.) Indian	Catmon	Leaves	0	0	***13.5	*13.5

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TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
GUTTIFEREAE:						
Calophyllum inophyllum L.	Bitaog	Leaves	***13.5	*13.5	***13.5	*13.5
Garcinia mangostana L.	Mangostan	Pericarp	*13.5	0	**13.5	0
BIXACEAE:						
Bixa orellana L.	Achuéte	Leaves	***22	0	0	**13.5
		Bark	**13.5	0	*13.5	0
		Seeds	**15.5	0	**13.5	0
VIOLACEAE:						
Viola odorata L.	Violeta	Leaves	0	0	**15.5	*13.5
FLACOURTIACEAE:						
Flacourtia ramontchi L. Herit.	Palutan	Leaves	0	0	***13.5	**13.5
Hydnocarpus alkalae C.	Chamulgra	Fruit	0	0	0	0
Pangium edule Reinw.	Pangi	Leaves	**13.5	*13.5	*13.5	0
CARICACEAE:						
Carica papaya L.	Papaya	Leaves	***22.5	0	0	0
		Roots	0	0	***21.1	*13.5
		Bark	0	0	***17.0	0
		Flowers	0	0	*13.5	**13.5
BEGONIACEAE:						
Begonia acuminatissima, Merr.	Begonia	Leaves	***18.0	0	0	0
LECYTHIDACEAE:						
Planchonia spectabilis Merr.	Lamog	Leaves	***19.0	0	**13.5	0
CACTACEAE:						
Cactus cochinellifera (L.) Salm-Dyck	Dilang-baka	Leaves	0	0	*13.5	*13.5
Cactus lepidotus L.		Stem	0	0	***17.5	0
Cactus triangularis F. Vill.		Leaves	0	0	***17.5	*14.0
THYMELAEACEAE:						
Wikstroemia ovata C.A. Mey.	Salago	Leaves	0	*13.5	*13.5	**13.5
LYTHRACEAE:						
Lagerstroemia indica L.	Molendres	Leaves	0	0	**14.6	0
Lagerstroemia speciosa L.	Banaba	Leaves	0	0	0	0
		Roots	*13.5	0	*13.5	0
RHIZOPHORACEAE:						
Bruguiera cylindrica L. Blm.		Leaves	0	0	**13.5	**13.5
Carallia brachiata (Lour.) Merr.		Leaves	0	0	**13.5	0
Rhizophora mucronata Lam.	Bakauan-babae	Leaves	*13.5	**13.5	*13.5	**13.5
Rhizophora tinctoria Blanco	Bakauan-gubat	Leaves	0	0	**13.5	*13.5
COMBRETACEAE:						
Lumnitzera racemosa Willd.	Kulasi	Leaves	0	0	*13.5	**13.5
MYRTACEAE:						
Callistemon lanceolatus, DC.	Bottle-brush tree	Leaves	***37.2	0	***18.7	**13.5

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TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
Eucalyptus tereticornis Sm.	Eucalyptus	Leaves	***20.5	0	**16.9	0
		Bark	***18.5	0	0	0
Syzygium cumini (L.) Skeels	Duhat	Leaves	**15.9	0	**13.5	**13.5
		Bark	*13.5	0	**18.5	0
		Roots	0	0	***13.5	0
Syzygium jambos (L.) Alston	Tampoi	Bark	0	0	***16.6	0
Syzygium samaragense L.	Makopa	Leaves	***19.6	0	*13.5	0
ARALIACEAE:						
Nothopanax cordifolia L.		Leaves	0	0	**13.5	**13.5
Nothopanax fruticosum (L.) Miq.	Papua-china	Leaves	0	0	**13.5	*13.5
Nothopanax guilfoyle (Cogn & March.)	Papua	Leaves	0	*13.5	0	0
UMBELLIFERAE:						
Apium graveolens L.	Celery	Leaves	0	*13.5	***13.5	**13.5
MYRSINACEAE:						
Maesa sp. L.	Maesa	Leaves	0	*13.5	**13.5	***13.5
PLUMBAGINACEAE:						
Plumbago auriculata Lam.		Leaves	0	0	0	**13.5
SAPOTACEAE:						
Achras zapota L.	Chico	Leaves	0	0	0	0
		Bark	0	0	***13.5	0
		Fruit	0	0	***13.5	**13.5
Chrysophyllum cainito L.	Caimito	Skin	0	0	**13.5	0
Lucuma nervosa A. DC.	Tiesa	Leaves	0	0	0	0
EBENACEAE:						
Diospyros ahernii Merr.	Anang	Leaves	*13.5	0	**13.5	**13.5
Diospyros discolor Willd.	Camagong	Leaves	***19.3	0	**13.5	**13.5
OLEACEAE:						
Jasminum grandiflora L.	Jasmin	Leaves	***17.5	0	***15.0	0
Jasminum sambac (L.) Ait.	Sampaguita	Leaves	0	0	*13.5	0
APOCYNACEAE:						
Allamanda cathartica	Campanilla	Leaves	0	0	0	0
Alstonia macrophylla Wall.	Batino	Leaves	0	0	***15.8	0
Alstonia scholaris (L.) R. Br.	Dita	Bark	0	**13.5	**13.5	***13.5
Lochnera rosea (L.) Reich.	Chichirica	Leaves	0	0	**13.5	*13.5
Parameria laevigata (A. Juss) Moldenke	Prugtongahas	Leaves	0	0	**13.5	**13.5
Tabernaemontana pandacaqui Poir.	Pandacaqui	Leaves	0	0	***17.5	0
CONVOLVULACEAE:						
Ipomoea aquatica Forsk.	Kangkong	Leaves	0	0	0	0
Ipomoea batatas (L.) Poir.	Kamote	Leaves	0	0	**13.5	*13.5

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TABLE 1.—*Results of antibacterial tests* [a]—Continued.

Plant [b]			Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
Scientific name	Local name	Part examined	*M. aureus*	*E. coli*	*M. aureus*	*E. coli*
Ipomoea hederaceae (L.) Jacq.	Kamokamotihan	Leaves	0	0	**13.5	*13.5
Ipomoea purpura L.	Morning glory	Leaves	0	0	**14.0	**13.5
Ipomoea triloba L.	Hilabagting	Leaves	0	0	**13.5	**13.5
Merremia gemella (Burm. f.)	Talanuk	Leaves	0	0	*13.5	0
Merremia peltata (L.) Merr.	Bulakan	Leaves	0	0	***13.5	**13.5
BORANGINACEAE:						
Ehretia microphylla Lam.	Chaang-gubat	Leaves	**13.5	**13.5	***13.5	**13.5
VERBENACEAE:						
Avicennia marina Vierh. var. inter.	Api-api	Leaves	0	**13.5	**13.5	**13.5
Callicarpa bicolor Schauer	Palis	Leaves	***20.6	0	***16.0	0
Clerodendron calamitosum L.		Leaves	0	0	***15.8	**13.5
Clerodendron intermedium, Cham.	Kasopangil	Leaves	0	0	**13.5	*13.5
Clerodendron thomsonae, Balf.	Secreto de amor	Leaves	0	0	0	*13.5
Duranta repens L.	Duranta	Leaves	0	**13.5	***13.5	0
Lantana camara L.	Coronitas	Leaves	0	0	***14.0	**13.5
Premna cumingiana Schauer	Magilik	Leaves	0	0	**13.5	*13.5
Premna nauseosa Blanco	Malauin-aso	Leaves	0	0	**15.0	0
Premna odorata Blanco	Alagaw	Leaves	0	0	**13.6	**13.5
		Bark	0	0	**13.5	*13.5
		Flowers	0	0	*13.5	0
		Fruits	0	0	*13.5	*13.5
		Roots	***16.3	0	*13.5	0
Premna subscandens Merr.	Alagaw-bagin	Leaves	0	*13.5	**13.5	**13.5
Stachytarpheta jamaicensis, (L.) Vahl.	Kandikandilaan	Leaves	0	0	*13.5	**13.5
Tectona grandis (L.) f.	Teak	Leaves	***22.3	0	***13.5	*13.5
Vitex parviflora Juss.	Molave	Leaves	0	0	**13.6	*13.5
Vitex trifolia	Lagunding-dagat	Bark	0	0	**13.5	*13.5
		Leaves	0	0	0	0
LABIATAE:						
Coleus amboinicus	Oregano	Leaves	0	0	***14.7	*13.5
Coleus blumei Benth.	Mayana	Leaves	**17.6	0	0	0
Acalypha hispida (L.) Blume	Buntot-pusa	Leaves	***24.2	0	***16.8	**13.5
Hyptis brevipes Poir.	Niog-niogan	Leaves	0	*13.5	***26.0	**13.5
Leonurus sibiricus L.	Kamariang-sungsong	Leaves	0	0	***13.5	**13.5
Mentha arvensis L.	Hierba buena	Plant	0	0	**13.5	0
SOLANACEAE:						
Cestrum nocturnum L.	Dama de noche	Leaves	0	0	***19.6	0
Lycopersicum esculentum, Mill.	Kamatis	Leaves	0	0	***16.5	**13.5
Nicotiana tabacum L.	Tabako	Leaves	0	0	**13.5	0
Petunia hybrida Hort.	Petunia	Leaves	*13.5	0	**13.5	*13.5

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TABLE 1.—*Results of antibacterial tests* [a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm.			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
SCROPHULARIACEAE:						
Scoparia dulcis L.	Mala-anis	Leaves	0	**13.5	***19.0	*13.5
BIGNONIACEAE:						
Cydista aecquinoctialis, L.	Bignonia	Leaves	***29.7	*14.0	**24.6	***18.5
Spathodea campanulata Beauv.	African tulip	Leaves	0	*13.5	**13.5	**13.5
ACANTHACEAE:						
Acanthus ebracteatus Vahl.	Tapilak	Leaves	0	0	*13.5	**13.5
Asystasia gangetica (L.) T. Anders.	Asistasya	Leaves	0	0	0	0
Crossandra undulaefolia, Salisb.		Leaves	0	*13.5	0	0
Eranthemum albomarginatum Hort.		Leaves	0	0	0	0
Graptophyllum pictum (L.) Griff.	Kalpueng	Leaves	0	0	**13.5	0
Justicia gendarussa Burm. F.	Kapanitulot	Leaves	0	0	0	***13.5
Pseuderanthemum reticulatum, (Radlk)	San Diego	Leaves	0	0	***16.3	***22.0
PLANTAGINACEAE:						
Jacobina coccinea Benth.	Justicia	Leaves	0	0	***13.5	***13.5
RUBIACEAE:						
Canthium monstrosum (A. Rich.) Merr.	Tadyang kalabao	Leaves	0	0	*13.5	0
		Bark	0	0	*13.5	0
		Roots	0	0	***13.5	0
		Flowers	0	0	***13.5	0
		Fruits	0	0	0	0
Gardenia augusta (L.) Merr.	Rosal	Leaves	0	0	0	*13.5
		Flower	0	0	*13.5	0
Gardenia pseudopsidium (Blanco) f. Vill.	Malabayabas	Leaves	0	0	**13.5	0
Ixora coccinea L.	Santan-pula	Flowers	0	0	0	0
Ixora finlaysoniana var. Wall.	Santan-dilaw	Leaves	0	0	0	0
Mussaenda philippica Var. *aurora* Sulit	Doña Aurora	Leaves	0	0	***17.9	***13.5
Oldenlandia corymbosa L.	Malaulasiman	Plant	*13.5	0	**13.5	**13.5
Psychotria luconensis (Cham. and Schlecht.) F.-Vill	Tagpo	Leaves	***18.6	0	***14.3	*13.5
CAPRIFOLIACEAE:						
Sambucus canadensis L.	Canadian elder	Leaves	**13.5	0	*13.5	0
CUCURBITACEAE:						
Bryonopsis laciniosa (L.) Naud.		Leaves	0	0	**13.5	**13.5
Citrullus vulgaris Schrad.	Pakuwán	Leaves	0	0	***21.3	0
Cucumis sativus L.	Cucumber	Fruit	0	0	**13.5	***20.0
Cucurbita maxima Duch.	Kalabasa	Leaves	0	0	*13.5	0
Luffa cylindrica (L.) M. Roem.	Patolang amerikano	Leaves	0	0	***17.3	**13.5
Momordica cochinchinensis, (Lour.) Spreng.	Patolang-uak	Leaves	0	0	**14.5	**13.5

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[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter of the halo zone in mm.

[b] The system of classification is patterned after that of Engler and Prantl.

TABLE 1.—*Results of antibacterial tests*[a]—Continued.

Plant[b]			Mean halo diameter of triplicate in mm			
Scientific name	Local name	Part examined	Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
CAMPANULACEAE:						
Isotoma longiflora (Mill.) Presl	Estrella	Leaves	0	0	***18.3	***17.1
COMPOSITAE:						
Blumea balsamifera (L.) DC.	Sambong	Leaves	*13.5	0	*13.5	*13.5
Blumea lacera (Burm. f.) DC.	Tubang kabayo	Leaves	0	0	0	*13.5
Carthamus tinctorius L.	Kasubha	Leaves	0	0	*13.5	0
Chrysanthemum sinense Sabine	Chrysanthemum	Leaves	0	0	***17.5	*13.5
Cosmos caudatus HBK	Cosmos	Leaves	0	0	**13.5	0
Crepis japonica (L.) Benth	Zinnias	Leaves	0	0	***15.3	**14.5
Elephantopus mollis HBK	Dilang-baka	Leaves	0	0	***20.3	**17.1
Gynura acuminatissima Merr.		Leaves	0	0	**13.5	*13.5
Gynura angulosa F. Vill.	Sabungai	Leaves	0	0	**13.5	*13.5
Helianthus annuus L.	Sun-flower	Leaves	0	0	**16.6	0
Lactuca sativa L.	Lechuga	Leaves	0	0	0	0
Mikania scandens (L.) (Juss.) Rohr.	Bikas	Leaves	**17.3	0	***17.9	**13.5
Pseudelphantopus spicatus, (Juss.) Rohr.	Dilang-aso	Leaves	**13.5	**13.5	**13.5	**13.5
Sphaeranthus alatus Blanco	Botobotonisan	Leaves	0	0	*13.5	*13.5
Vernonia patula (Dry) Nurr.		Leaves	0	*13.5	**13.5	*13.5

[a] Activity against test organisms is indicated by * * * for complete inhibition; * * for partial inhibition; * for slight indication of inhibition; 0 for no effect. The numbers refer to the diameter of the halo zone in mm.

[b] The system of classification is patterned after that of Engler and Prantl.

The distribution of antibacterial substances in different parts of most Philippine medicinal plants is quite uneven as shown in Table 2 and the parts used for medication neither always possess the antibacterial properties nor always show highest inhibitive activity against the test organism *M. aureus.* A similar observation was reported by George and Pandalai (7) in the case of Indian medicinal plants.

Table 3 shows the plant families represented in this investigation, the number of species tested under each family and the number of species which caused the inhibition of *M. aureus* and *E. coli.* As may be seen by scrutinizing the measurements of the zone of inhibition of the test organisms, the species containing the antibacterial substances are widely,

TABLE 2.—*Variation in the distribution of antibacterial substances in the different parts of common medicinal plants.*

Plant	Parts examined	Zone of inhibition of *M. aureus* in mm.	
		Alcoholic extract	Aqueous extract
Guava (*Psidium guajava* L.)	Leaves ×	***19.6	0
	Bark	***13.5	***16.5
	Roots	0	**13.5
	Flowers	***20.4	***13.5
	Fruits	***16.1	***13.5
Duhat [(*Syzygium cumini* (L.)] Skeels	Leaves	***15.9	**13.5
	Barks ×	*13.5	**18.5
	Roots	0	***13.5
Alagaw (*Premna odorata* Blanco)	Leaves ×	0	**13.5
	Barks	0	**13.5
	Roots	***16.5	*13.5
	Flowers	0	*13.5
	Fruits	0	*13.5
Sampaloc (*Tamarindus indica* L.)	Leaves ×	0	0
	Bark	0	*13.5
	Roots	*13.5	*13.5
	Flowers	***16.7	***13.5
	Fruits (green)	0	***13.5
Malunggay (*Moringa oleifera* Lam.)	Leaves	***25.6	***20.3
	Bark	*16.0	***16.0
	Roots ×	0	***13.5
	Flowers	***29.0	***19.5
	Fruits	***22.5	**13.5

× Parts frequently used in the treatment of abscesses, boils, and sores

TABLE 3.—*Distribution of plants which have been tested for antibacterial properties according to families.*

Family	Number of species tested	Number of species showing positive reaction against:			
		M. aureus		*E. coli*	
		Alcoholic extract	Aqueous extract	Alcoholic extract	Aqueous extract
Pteridaceae	1	0	1	0	1
Polypodiaceæ	4	0	4	0	1
Cycadaceæ	1	0	1	1	1
Pinaceæ	1	1	1	0	0
Gnetaceæ	1	0	1	0	1
Pandanaceæ	2	0	1	0	1
Gramineæ	6	0	6	1	5
Cyperaceæ	1	0	1	0	1
Palmae	4	1	3	0	3
Araceæ	6	0	5	0	5
Bromeliaceæ	1	1	1	0	1
Commelinaceæ	2	0	2	1	2
Liliaceæ	7	1	5	1	3
Amaryllidaceæ	5	0	5	0	4
Dioscoraceæ	1	0	1	0	1
Musaceæ	2	0	1	0	2
Zingiberaceæ	7	1	4	2	5
Cannaceæ	1	0	1	0	0
Marantaceæ	1	0	1	0	1
Orchidaceæ	1	0	1	0	1
Casuarinaceæ	1	1	1	0	1
Piperaceæ	5	2	5	0	3
Ulmaceæ	3	1	3	1	2
Moraceæ	13	4	12	1	11
Urticaceæ	3	0	3	0	3
Olacaceæ	1	1	1	0	1

TABLE 3.—*Distribution of plants which have been tested for antibacterial properties according to families*—Continued.

Family	Number of species tested	Number of species showing positive reaction against:			
		M. aureus		*E. coli*	
		Alcoholic extract	Aqueous extract	Alcoholic extract	Aqueous extract
Aristolochiaceæ	1	0	1	0	1
Polygonaceæ	2	0	2	0	1
Chenopodiaceæ	3	0	2	0	2
Amaranthaceæ	7	0	7	1	6
Nycthaginaceæ	2	0	2	0	1
Nymphaeaceæ	2	1	2	0	1
Menispermaceæ	4	0	3	1	3
Anonaceæ	3	3	2	2	2
Lauraceæ	1	0	1	0	0
Cruciferæ	3	1	2	1	3
Capparidaceæ	3	1	2	0	3
Moringaceæ	1	1	1	0	1
Crassulaceæ	2	0	0	0	0
Pittosporaceæ	1	0	1	0	1
Rosaceæ	1	0	1	0	0
Connaraceæ	1	1	1	1	0
Leguminosæ	38	13	35	7	29
Oxalidaceæ	3	0	2	0	1
Rutaceæ	6	2	5	1	5
Burseraceæ	1	1	1	0	1
Meliaceæ	4	3	4	0	2
Euphorbiaceæ	27	12	22	4	18
Anacardiaceæ	4	3	4	1	4
Celastraceæ	1	0	1	0	1
Icacinaceæ	1	0	1	1	1
Sapindaceæ	3	2	3	0	2
Balsaminaceæ	1	1	1	0	1
Rhamnaceæ	2	1	1	1	0
Vitaceæ	3	1	2	0	1
Tiliaceæ	5	1	4	1	3
Malvaceæ	12	2	12	0	8
Bombaceæ	2	2	2	0	0
Sterculiaceæ	5	1	5	0	4
Dilleniaceæ	1	0	1	0	1
Guttiferæ	2	2	2	1	1
Bixaceæ	1	1	1	0	1
Violaceæ	1	0	1	0	1
Flacourtiaceæ	3	1	2	1	1
Caricaceæ	1	1	1	0	1
Begoniaceæ	1	1	0	0	0
Lecythidaceæ	1	1	1	0	0
Cactaceæ	3	0	3	0	2
Thymelaeaceæ	1	0	1	1	1
Lythraceæ	2	0	1	0	0
Rhizophoraceæ	4	1	4	1	3
Combretaceæ	1	0	1	0	1
Myrtaceæ	6	5	6	1	3
Araliaceæ	5	1	4	1	3
Umbelliferæ	2	0	2	1	2
Myrsinaceæ	1	0	1	1	1
Plumbaginaceæ	1	0	0	0	1
Sapotaceæ	3	0	2	0	1
Ebenaceæ	2	2	2	0	2
Oleaceæ	2	1	2	0	0
Apocynaceæ	9	1	8	1	6
Convolvulaceæ	8	0	7	0	5
Boranginaceæ	3	1	3	2	3
Verbenaceæ	16	3	14	3	12
Labiatæ	7	2	6	1	5
Solanaceæ	6	1	6	1	4
Scrophulariaceæ	1	0	1	1	1
Bignoniaceæ	2	1	2	2	2
Acanthaceæ	7	0	3	1	4
Plantaginaceæ	1	0	1	0	1
Rubiaceæ	8	2	6	0	4
Caprifoliaceæ	1	1	1	0	0
Cucurbitaceæ	7	0	7	0	4
Campanulaceæ	1	0	1	0	1
Compositæ	18	3	16	2	14

but unevenly, distributed among the different families examined. Also, the extracts containing the antagonistic constituents against *M. aureus* are frequently encountered in many species belonging to the families Moraceæ, Leguminosæ, Euphorbiaceæ, Malvaceæ, Verbenaceæ, and Compositæ, while those against *E. coli* are found in many species of the family Moraceaæ.

The species containing antibiotic substances which possess great power of inhibiting one or both test organisms are presented in Table 4. The plants having marked antagonistic effect on both test organisms are *Polanisia icosandra* (Linn.) W. & A., *Cydista æquinoctialis* Linn. (Bignonia), *Alternantera vericolor* Hort. (Kutsarita), *Elephantopus mollis* HBK (Tabacotabacohan), and *Gnetum gnemon* Linn. (Bago).

The aqueous extracts of a few plants, particularly those from *C. æquinoctialis* (Bignonia) and *Allium sativum* Linn. (Bauang) formed broad zones each with two distinct concentric rings when tested against *M. aureus.* The inner and outer rings showed respectively complete and partial inhibitions (Plate 2, figs. 1 and 2). Such a distinct difference in the degree of inhibition suggests the existence of more than one antibacterial compounds with different diffusibilities. Other factors such as the presence of toxic organic acids may also contribute to such an occurrence.

TABLE 4.—*Plants possessing high antibacterial substances against either or both test organisms.*

Scientific name	Local name	Part examined	Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
POLYPODIACEAE:						
Drynaria quercifolia (Bory) J. Smith	Paipai-amo	Leaves	0	0	***22.5	*13.5
Pityrogramma calomelanos (L). Link	Elecho	Leaves	0	0	***24.0	0
GNETACEAE:						
Gnetum gnemon L.	Bago	Leaves	0	0	***21.7	***17.0
GRAMINEAE:						
Saccharum officinarium L.	Tubo	Leaves	0	0	***17.8	***15.5
ARACEAE:						
Amorphophallus campanulatus (Roxb.) Blume	Pungapong	Leaves	0	0	***23.3	***13.5
BROMELIACEAE:						
Dendropogon usneoides L.	Bohok ni Ester	Leaves	*13.5	0	***24.0	*13.5

TABLE 4.—*Plants possessing high antibacterial substances against either or both test organisms*—Continued.

Scientific name	Local name	Part examined	Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
LILIACEAE:						
Allium sativum L.	Bawang	Bulb	**33.0	***18.0	**29.0	***22.0
Asparagus officinalis L.	Asparagus	Whole plant	0	0	***34.0	**14.0
DIOSCORACEAE:						
Dioscoracea alata L.	Ubi	Leaves	0	0	**13.5	*** 19.5
PIPERACEAE:						
Piper retrofractum Vahl.	Litlit	Leaves	***20.1	0	**14.0	***14.0
MORACEAE:						
Artocarpus altilis (Parkins) Fosb.	Rimas	Roots	***20.0	0	*13.5	*13.5
Ficus ulmifolia Lam.	Isis	Leaves	0	0	***28.0	0
Streblus asper Lour.	Kalios	Bark	0	0	***21.8	**13.5
AMARANTHACEAE:						
Achyranthes aspera L.	Hanggod	Leaves	0	0	***23.6	0
CAPPARIDACEAE:						
Polanisia icosandra (Linn) W. & A.	------------	Whole plant	*13.5	0	***22.2	***23.6
MORINGACEAE:						
Moringa oleifera Lam.	Malunggay	Leaves	***25.6	0	***20.3	**14.0
		Flowers	***29.0	0	***19.5	0
		Fruit	***22.5	0	**13.5	0
PITTOSPORACEAE:						
Pittosporum pentandrum (Blanco) Merr.	Mamalis	Leaves	0	0	***22.3	*13.5
LEGUMINOSAE:						
Caesalpinia crista Perk.	Kalumbibit	Leaves	***20.1	0	**13.5	0
Cassia sophera L.	Andadasi	Leaves	***20.0	0	**13.5	*13.5
Cassia tora L.	Balatong-aso	Leaves	0	0	***20.6	**13.5
Indigofera suffroticosa Mill.	Tayum	Leaves	***21.0	0	**13.5	*13.5
Intsia bijuga (Colebr.) O. Kntze	Ipil	Leaves	0	**13.5	***20.1	**13.5
Pithecolobium dulce (Roxb.) Benth	Kamatsili	Bark	***20.1	0	***20.3	0
RUTACEAE:						
Citrus grandis Osbeck	Suha	Bark	*15.5	0	***21.0	*17.0
Murraya paniculata (L.) Jack	Kamuning	Leaves	0	0	0	***18.0
EUPHORBIACEAE:						
Codiaeum variegatum (L.) Blume	San Francisco	Leaves	0	0	***21.6	*13.5
Euphorbia pilulifera L.	Botobotonis	Leaves	***14.0	0	***23.5	**13.5
Fluggea virosa (Roxb.) Bail.	Botolan	Leaves	***22.0	**13.5	*13.5	**13.5
Mallotus ricinoides (Pers.) Muell-Arg.	Hinlaumo	Leaves	***26.5	0	**13.5	0
Pedilanthus tithymaloides L.	Luha	Leaves	0	0	***22.0	0
Phyllanthus niruri Blanco	Sampa-sampalocan	Leaves	***20.1	0	***13.5	**13.5

TABLE 4.—*Plants possessing high antibacterial substances against either or both test organisms*—Continued.

Scientific name	Local name	Part examined	Mean halo diameter of triplicate in mm.			
			Alcoholic extract		Aqueous extract	
			M. aureus	*E. coli*	*M. aureus*	*E. coli*
CELASTRACEAE:						
Euonymus javanicus Blume	Tabaan	Leaves	0	0	**14.0	***19.6
TILIACEAE:						
Muntigia calabura L.	Datiles	Leaves	***20.3	0	**13.5	*13.5
BIXACEAE:						
Bixa orellana L.	Achuete	Leaves	***22.0	0	0	**13.5
CARICACEAE:						
Carica papaya L.	Papaya	Leaves	***22.5	0	0	0
		Roots	0	0	***21.1	*13.5
MYRTACEAE:						
Callistemon lanceolatus, DC.	Bottle brush tree	Leaves	***37.2	0	***18.7	**13.5
Eucalyyptus terclicornis Sm.	Eucalyptus	Leaves	***20.5	0	**16.9	0
VERBENACEAE:						
Callicarpa bicolor Schauor	Palis	Leaves	***20.6	0	***16.0	0
Tectona grandis (L.) f.	Teak	Leaves	***22.3	0	***13.5	*13.5
LABIATAE:						
Acalypha hispida Burm. f.	Buntot-pusa	Leaves	***24.2	0	***16.8	**13.5
Hyptis brevipes Poir.	Niog-niogan	Leaves	0	*13.5	***26.0	**13.5
BIGNONIACEAE:						
Cydista aequinoctialis L.	Bignonia	Leaves	***29.7	*14.0	**24.6	***18.5
ACANTHACEAE:						
Pseuderanthemum reticulatum Radlk.	San Diego	Leaves	0	0	***16.3	***20.0
CUCURBITACEAE:						
Citrullus vulgaris Schrod.	Pakuwán	Leaves	0	0	***21.3	0
Cucumis sativus L.	Pepino	Fruit	0	0	**13.5	***20.0
CAMPANULACEAE:						
Isotoma longiflora L.	Estrella	Leaves	0	0	***18.3	***17.1
Elephantus mollis HBK	Dilang-baka	Leaves	0	0	***20.3	**17.1

The above tests are qualitative and do not at all portray the true reactions of the active substances against the test organisms, but they are necessary in the search for new antibacterial substances. The quantitative amount and useful evaluation of any antibacterial substance can only be known when the active principle is isolated, purified and tested. Studies on the isolation of the active principles of *C. æquinoctialis* (Bignonia), *Muntingia, calabura* Linn. (Datiles), and *Samanea saman* (Jacq.) Merr. (Acasia) are in progress.

SUMMARY

1. Three hundred twenty nine species of Philippine higher plants from 95 families were screened for the presence of substances inhibitory to *Micrococcus aureus* Zopf. and *Escherichia coli* (Migula) Castellani and Chalmers.

2. The antibacterial substances were extracted separately with 95 per cent ethyl alcohol or with distilled water. A total of 802 extracts, 401 alcoholic, and 401 aqueous were prepared. Of the alcoholic extracts tested, 107 caused inhibition of *M. aureus* and 51 *E. coli*. The aqueous extracts antagonistic to *M. aureus* were 333 and to *E. coli*, 258.

3. The antibacterial substances were unevenly distributed in various parts of the plants.

4. Many medicinal plants do not contain substances with pronounced antibacterial properties. Likewise, the medicinal parts of the plants neither always possess the antibacterial properties nor always show the highest inhibitive activity against the test organism *M. aureus*.

5. The antagonistic activity against *M. aureus* was observed frequently in many species of Moraceæ, Leguminosæ, Euphorbiaceæ, Malvaceæ, Verbenaceæ, and Compositæ.

6. Extracts inhibiting *E. coli* were obtained from many species of the family Moraceaæ.

7. Species possessing substances with marked antagonistic effect on both test organisms are *Polanisia icosandra* (Linn.) W. & A., *Cydista æquinoctialis* Linn. (Bignonia), *Elephantopus mollis* HBK (Tabacotabacohan), and *Gnetum gnemon* Linn. (Bago).

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ILLUSTRATIONS

Plate I

Fig. 1. Alcoholic extract of leaves of *Bixa orellana* Linn. (Achuete) tested for antibacterial activity against *M. aureus*. Note the complete zones of inhibition around the three filter-paper discs wet with the extract and absence of a halo around the control disc.

2. Inhibitive activity of the alcoholic extract of leaves of *Psidium guajava* Linn. (Bayabas) against *M. aureus*.

3. Halo zones of inhibition of *M. aureus* formed by the aqueous extract of leaves of *Moringa oleifera* Lam. (Malungay).

4. Aqueous extract of leaves of *Acacia farnesiana* (L) Willd. (Aroma) inhibits growth of *M. aureus*.

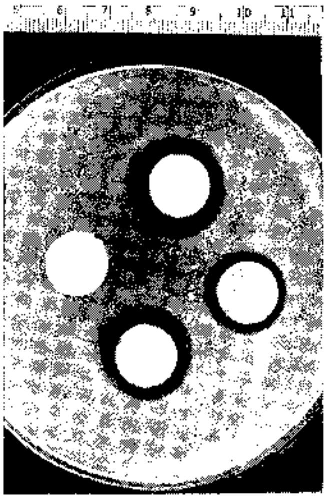
Plate 2

Fig. 1. Aqueous extract of the bulb of *Allium sativum* Linn. (Bauang) tested for presence of substances inhibitory to *M. aureus*. Note the two distinct rings of inhibition around the discs saturated with the extract; the inner clear ring is here considered as a case of complete inhibition, the outer cloudy ring, partial.

2. Antibacterial activity of the aqueous extract of leaves of *Cydista æquinoctialis* Linn. (Garlic vine) against *M. aureus*. The extract caused also the formation of two distinct zones of inhibition around the discs wet with the extract. The inner zones which are very close to the periphery of the discs show complete inhibition, the outer partial.

3. Complete inhibition of *E. coli* caused by the aqueous extract of the bulb of *A. sativum*.

4. Aqueous extract of the leaves of *C. æquinoctialis* inhibited growth of *E. coli*.



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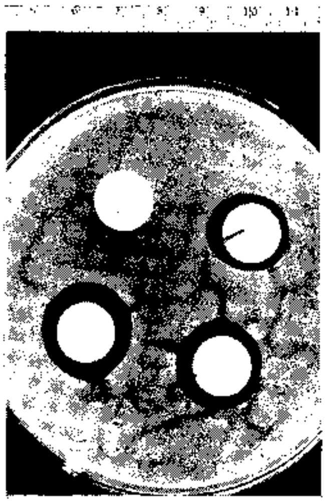

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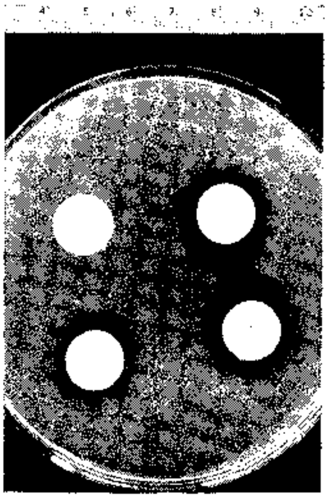

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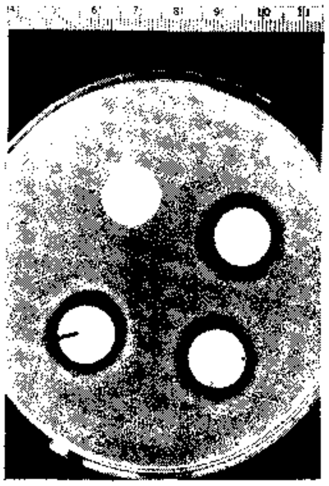

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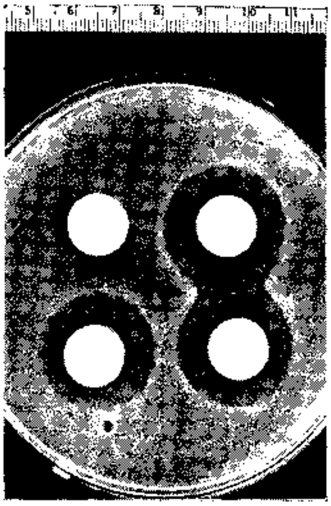
PLATE 1.



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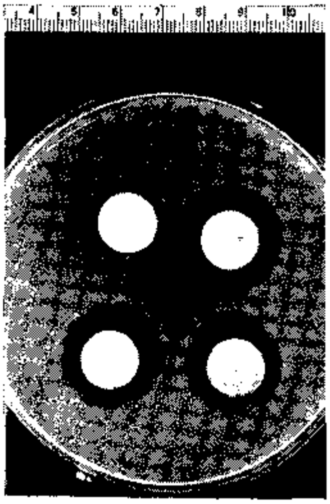

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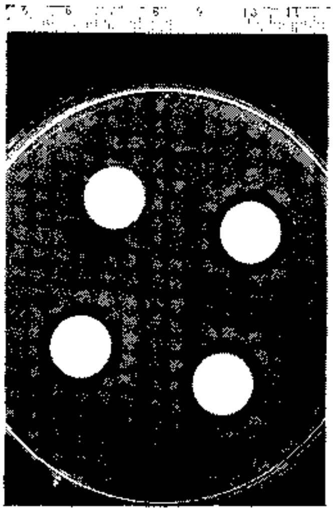

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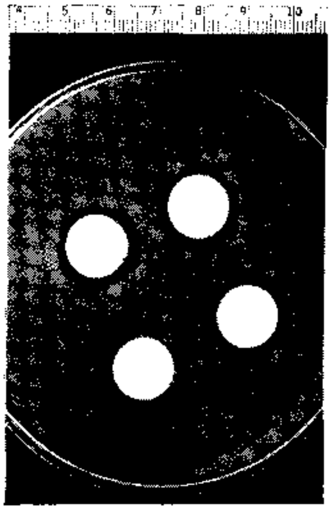

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PLATE 2.

DEHYDRATION OF CASTOR OIL FOR PAINTS AND ALLIED PRODUCTS USING LOCAL DEHYDRATING MATERIALS

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Castor oil is obtained by expression or by solvent extraction from the seeds of *Ricinus Communis* of the Euphorbiaceæ family, which grows either wildly or in cultivation in most tropical and sub-tropical regions. The plant varies greatly in size (6 to 35 ft.), in the color of the stems, as well as in the size and color markings of the more or less mottled seed. These marked variations are due to the existence of several varieties and, to some extent, to the differences in climate and soils. The seeds range in weight from 0.1 to 1.3 grams, the oil content being from 35 to 55 per cent, with an average of about 45, the kernels being from 70 to 80 per cent.

Two grades of castor oil are recognized by the trade: No. 1 which is obtained by the first cold pressing of the beans and which is practically colorless and suitable for medicinal purposes and No. 3 also known as industrial castor oil, which is obtained by further pressing or by solvent extraction, which is more or less colored (1).

Industrial castor oil may be processed and converted into desirable and even essential items which find varied uses in the manufacture of plastics, rayon, nylon, asphalt floor tile, rubber insulations, fungicides, rubber products, soaps, imitation leather, and lubricants (11). Of special significance is its application in protective and decorative coatings. The oil, which is generally absolutely non-drying, can be converted to one with high drying properties. In view of this possibility, the present study on the dehydration of castor oil for paints and allied products using local dehydrating materials has been undertaken.

Studies on castor oil dehydration have been conducted as early as 1913 when Rassow (15) recognized that heating castor oil in the presence of catalysts such as phosphoric and sulfuric acids split out water and increased the unsaturation. In 1914, Fokin(6) compared the products obtained by heating ricinoleic acid (from castor oil) and phosphoric pentoxide with the acid from linseed and tung oils. Proposed specifications for dehydrated castor oil were discussed by Colbeth(4) and Scofield(16).

Greaves(8) obtained consistent results in the drying time test by first aging the treated oils for at least five days. Radlove, De Jong, and Falkenburg(14) presented a continuous process for dehydration of castor oil using complicated equipment and H_2SO_4 as catalyst. Bryson(2) also conducted studies on H_2SO_4 as catalyst for castor oil dehydration. The use of sodium bisulfate and sodium bisulfite in the preparation of dehydrated castor oil was tried by Sivasamban, et al.(17). The composition of nine samples and the analysis of dehydrated castor oil was discussed by Priest and von Mikusch(13). Attention is called also to the investigations by Forbes and Neville(7) on the use of clays, acid derivatives of sulfuric acid, and oxides of certain metals for increasing the unsaturation in long chain fatty acids of castor oil. Grummit and Marsh(9) effectively dehydrated castor oil by non-conjugated oil—maleic anhydride adducts. Chen and Chang(3) activated Taiwan clays and used these in the preparation of dehydrated castor oil. On account of its non-yellowing properties Mundy(12) reported that dehydrated castor oil is particularly useful in making oil fabrics in place of window glass.

In a recent article in the Paint, Oil and Chemical Review(10), it has also been reported that considerable interest has been focused on the use of dehydrated castor oil in the manufacture of house paints due to its superior elasticity, high degree of water resistance and better color retention.

EXPERIMENTAL PROCEDURE

The castor oil used in this investigation was prepared by expression in the Institute of Science and Technology Castor Oil Pilot Plant. Its iodine value was 85.6.

The catalysts used for the dehydration reaction were the same samples of clay, the bleaching properties of which were reported by Cruz and Valencia(5).

The general method of treatment consisted in preheating the oil to the desired temperature, then adding a known amount of clay and stirring the mixture for a definite length of time. In order to arrive at the best conditions of treatment three series of experiments were conducted in which each of the three factors was varied while the two others were constant. The treated oil was then filtered with the aid of suction to remove the clay. To determine the degree of dehydration attained, the iodine value of the treated oil was determined. Results of these treatments are shown in Tables 1 to 3.

TABLE 1.—*Variable factor: amount of clay used; temperature, 240° C; time of treatment, 30 minutes.*

Amount of clay	Clay No. 13		Clay No. 4		Clay No. 5	
	Iodine value	Loss of oil	Iodine value	Loss of oil	Iodine value	Loss of oil
Per cent		*Per cent*		*Per cent*		*Per cent*
2.5	119.8	0.9	95.3	0.4	92.5	1.9
5.0	141.3	2.0	115.2	1.9	102.4	2.3
7.0	149.4	2.5	132.9	3.3	124.7	3.3
10.0	150.8	5.2	122.5	3.9	120.9	3.8

TABLE 2.—*Variable factor: duration of treatment; temperature, 240° C; amount of clay used, 7 per cent on the weight of the oil.*

Duration of treatment	Iodine value		
	Clay No. 2	Clay No. 7	Clay No.3
Minutes			
10	124.1	99.6	111.5
20	128.3	103.1	113.3
30	131.8	109.9	123.9
40	--------	--------	126.1

TABLE 3.—*Variable factor: temperature; amount of clay used, 7 per cent on the weight of the oil; time of treatment, 30 minutes.*

Temperature	Iodine value		
	Fuller's earth	Clay No. 13	Clay No. 6
Degrees centigrade			
190	--------	123.3	--------
200	--------	137.9	89.5
220	--------	143.3	93.1
240	137.6	149.4	108.4
260	140.6	--------	110.5
280	147.0	--------	------

As may be observed from Table 1, the iodine value of the corresponding treated oil increased as the amount of clay used was increased. For clays 4 and 5 an amount of 7 per cent of clay, calculated on the weight of oil used, gave the best results. Clay 13 gave a slightly higher iodine value when used in the amount of 10 per cent. In Table 2, the longer the time of treatment the higher is the iodine value of the treated oil. The same is true with temperature change in Table 3. In this series of experiments high iodine values were obtained for treatment at 280° C, but the oils obtained were too dark colored for use in paints. In order to obtain the optimum temperature and length of time of treatment, three experiments were again conducted at 240° C, 260° C, and 280° C, using only a single sample of clay as catalyst. Portions of the treated oil were drawn out after 10, 20, and 30 minutes of treatment. The iodine values of the oils so obtained are shown in Table 4.

TABLE 4.—*Amount of clay, 7 per cent.*

Duration of treatment	Iodine value of oils treated at different temperatures		
	240°C	*260°C*	*280°C*
Minutes			
10	----------	133.9	148.4
20	----------	132.9	146.6
30	137.6	140.6	147.0

Results obtained in Table 4 indicate that treatment for 10 minutes at 280° C gives the highest iodine value. The treatment at 280° C beyond 10 minutes gives oils that are too dark in color for use in paints and varnishes. The catalytic properties of several local clays were tested after the optimum conditions: namely, the amount of clay (calculated on wt. of oil), 7 per cent; temperature, 280° C; time, 10 minutes; stirring, 250 rpm, were obtained. A summary of the results obtained is given in Table 5.

TABLE 5.—*Comparison of the catalytic property of some Philippine clays from different sources, in the dehydration of castor oil. Amount of clay used, 7 per cent; temperature, 280° C; time, 10 minutes.*

Clay number	Clay location	Iodine value
	A. Zambales, Olongapo U. S. Naval Reservation:	
1	Km 116½ deposit, below South turn	104.8
2	Km 122, deposit	142.2
3	Km 123-124 (clear)	115.8
4	Km 123-124 (colored)	138.8
5	American Housing Project	133.8
6	Salungahin, 1½ Km, South of Subic Poblacion	120.1
7	Km 123$^1/_2$, deposit	111.9
8	Zambales, Subic Felipen	89.7
	B. Rizal:	
9	Antipolo, 2 Km from Antipolo Church (back)	117.6
	C. Nueva Ecija:	
10	Caranglan, Pantabangan Road at Amot Creek, Salvacion	85.5
	D. Cebu:	
11	Toledo, Barrio Anajin	108.2
	E. Imported:	
12	Fuller's earth	148.4

Table 3 and Table 5 show that clays 2, 4, 5, and 13 are the most efficient catalysts for the dehydration of castor oil since they produce oils with an iodine value above 130. Oils having an iodine value of 130 and above are classified as drying oils.

Forbes and Neville (7) conducted a similar study on castor oil dehydration. Table 6 gives a comparison of the results obtained by use of local clays with those obtained by foreign authors.

TABLE 6.—*Comparison of some Philippine clays as dehydrating materials with those used by foreign authors.*

Catalysts		Temperature	Time	Iodine value of treated oil
	Per cent	*Degrees centigrade*	*Minutes*	
Philippine clays:				
Clay No. 13	7	240	30	149.4
Clay No. 13	5	240	30	141.4
Clay No. 2	7	240	30	131.8
Clay No. 2	7	280	10	142.2
Clay No. 4	7	280	10	138.8
Clay No. 4	7	240	30	132.9
Foreign materials:				
Kaolin	10	230-240	30	137.7
Kaolin	4	230-240	30	135.6
No. 1 wareclay	4	235-240	75	139.4
Copper sulfate	4	220-257	30	137.5
Sodium bisulfate	2	240-253	34	135.0
Sodium pyrosulfate	1	240-250	60	134.9
Taiwan clays activated with 20% H_2SO_4		200-250	30-40	104-148

The dehydrated oils which gave an iodine value of 130 and above were also tested for acid value and viscosity to see if they conform to the ASTM Specifications for dehydrated castor oil. Table 7 shows a comparison of the properties of castor oil dehydrated with some Philippine clays with ASTM Specifications.

TABLE 7.—*Comparison of the properties of castor oil dehydrated with some Philippine clays with ASTM Specifications.*

Dehydrated castor oil prepared with clay No.	Iodine value	Acid value	Viscosity (Poises)
2	142.2	1.6	1.69
4	138.8	1.6	1.8
5	133.8	1.2	1.7
ASTM Spec., min. iodine and max. acid value	135.0	2.5	1.6-2.5

The drying time of the prepared dehydrated castor oil was determined and compared to that of boiled lumbang oil and boiled linseed oil. It was found that dehydrated castor oil dries in three hours. Boiled linseed oil dries in six hours while boiled lumbang oil dries in 11 hours.

SUMMARY

Eleven samples of Philippine clays were used as catalysts for castor oil dehydration. With the exception of clay number 10 all the other clays produced a considerable increase in the iodine value of the oil from 85.6 to as high as 149.4. Clays 2, 4, 5, and 13 gave the best drying oils with iodine values 142.2, 138.8, 133.8, and 149.4 respectively. The samples of dehydrated castor oil were found to conform to the ASTM Specifications for dehydrated castor oil. The drying time of the prepared dehydrated castor oil compared favorably with boiled lumbang and linseed oils. Dehydrated castor oil prepared with some Philippine clays has better drying properties than oils prepared with imported dehydrating materials.

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THE PHONEMES OF BILAAN[1]

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ONE TEXT FIGURE

INTRODUCTION

There are said to be more than twenty thousand Bilaans located mainly in the province of Cotabato of Southern Mindanao, and also on the small islands of Sarangani and Balut.

There are some features about this group of people that seem to indicate a strikingly diverse relationship from other Philippine language groups.[2] Some of these are:[3]

(*a*) Creation story. The elements in the Bilaan story of the creation are very different from other Philippine accounts, as will be seen from the following, taken from Sir James Frazer's book 'Folk-Lore in the Old Testament'.[4]

> The Bilaan, a tribe of Mindanao, one of the Philippine Islands, relate the Creation of Man as follows:
>
> They say that in the beginning there was a certain being named Melu, of a size so huge that no known thing can give any idea of it; he was white in color and had golden teeth, and he sat upon the clouds, occupying all the space above. Having a very cleanly habit, he was constantly rubbing himself in order to preserve the whiteness of his skin unsullied. The scurf which he thus removed from his person he laid on one side, till it gathered in such a heap as to fidget him. To be rid of it, he constructed the earth out of it, and being pleased with his work, he resolved to make two beings like himself, only much smaller in size. He fashioned them accordingly in his own likeness out of the leavings of the scurf[5] whereof he had molded the earth, and these two

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[1] As used by the people themselves the name is actually */blaan/*.

[2] Harold C. Conklin identifies Tiruray, Bilaan and Tagabili as belonging to a southern Philippine group which is notably distinct from other Mindanao dialects. Preliminary Linguistic Survey of Mindanao (May, 1955).

[3] Sincere appreciation to Prof. H. Otley Beyer for drawing our attention to the first two following items.

[4] Frazer, Sir James George. Folk-Lore in the Old Testament. Abridged Edition. London 1 (1923).

[5] Beyer points out that the word used for the double skin disease which results in a scurf or scaling of the outer layers of skin is *buni* in several languages, (cf. Tagalog *buni* 'ringworm, barber's itch'), while in others the same word means supreme god (cf. Bontoc *ka-buni-an* 'Supreme God').

were the first human beings. But while the Creator was still at work on them, and had finished one of them all but for the nose, and the other all but for the nose and one other part, Tau Dalom Tana came up to him and demanded to be allowed to make the noses. After a heated argument with the Creator, he got his way and made the noses, but in applying them to the faces of our first parents, he unfortunately placed them upside down. So warm had been the discussion between the Creator and his assistant in regard to the noses that the Creator quite forgot to finish the other part of the second figure and went away to his place above the clouds leaving the first man or the first woman (for we are not told which) imperfect; and Tau Dalom Tana also went away to his place below the earth. After that a heavy rain fell, and

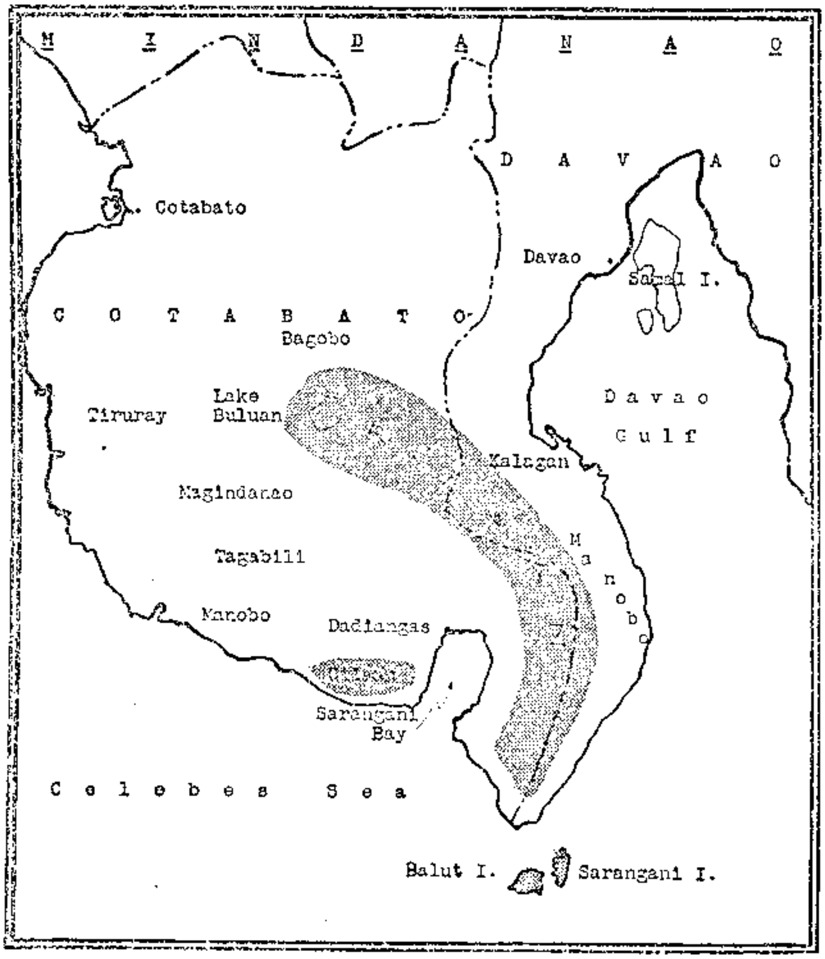

FIG. 1. Map showing approximate location of the Bilaan people and the names of their neighbors.

the two first of human kind nearly perished, for the rain ran off the tops of their heads into their upturned nostrils. Happily the Creator perceived their plight, and coming down from the clouds to the rescue, he took off their noses and replaced them right end up.

(*b*) Feathered hats. According to Beyer, the Bilaans formerly wore hats with black feather plumes passing from front to back in the form of a V, which were very similar to carvings on the Borobudur Temple, near Jogjakarta, Java.

(*c*) Abaca cloth. This cloth is hand woven by various groups in Mindanao, with very intricate patterns. In the Bilaan cloth there is a central section, the major portion of which is made up of white threads, in contrast to those woven by their neighbors, the Kalagans and the Tagabilis.

(*d*) Linguistic aspects. Three observations of the language itself which make it rather unique as a Philippine language are: the presence of seven vowel phonemes, word initial consonant clusters, and word final *h*. Most other Philippine languages have only three or four vowels, with the known exception of Tagabili, which has seven also. Comparison of the Bilaan vowel system with that of Javanese, as indicated by Dempwolff,[6] shows the two to be very similar.[7] We do not know whether the seven vowel phones listed for Javanese are all phonemes, but the parallel is close enough to deserve attention. Word initial consonant clusters and final *h* rarely occur in Philippine languages. Dyen listed final *h* as one feature which is not attested in the data he worked with.[8]

The materials for this article were gathered over a period of approximately five months during the years of 1953-54 under the auspices of the Summer Institute of Linguistics. The main informant was a young man of twenty-one years, Arsenio Malayang Garciano, living in the Sitio of Kablan, near the foot of Mt. Matutum. He has completed grade four schooling, and speaks some English, some Visayan, and a little Tagalog in addition to his own language.

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[6] Dempwolff, Otto. Vergleichende Lautlehre Des Austronesischen Wortschatzes (Berlin, 1934) 26.

[7] Appreciation to Dr. R. S. Pittman for this observation and his generous assistance, along with Mr. D. Thomas, in their helpful constructive criticism.

[8] Dyen, Isidore. The Proto-Malayo-Polynesian Laryngeals (Baltimore, 1953) 17–18.

CONSONANTS

There are fifteen consonant phonemes. These consist of:

Six stops—

	Voiced			Voiceless		
Bilabial	/b/	/bà/	'mouth'			
Alveolar	/d/[9]	/dee/[10]	'there'	/t/	/tee/	'excrement'
		/adluh/	'to chase'		/atluh/	'straight'
Velar	/g/	/gu/	'I'	/k/	/ku/	'if'
		/kafɑg/	'dry'		/fɑfɑk/	'wing'
Glottal				/ˋ/	/balò/	'bolo'
					/lial/	'neck'

Nine continuants—

Fricatives

Labiodental flat /f/[11], Alveolar grooved /s/, Glottal /h/

Nasals

Bilabial /m/, Alveolar /n/, Velar /ñg/[12]

Lateral

Alveolar /l/

Nonsyllabic vocoids

Back /w/, Front /y/.

Examples: /fufuñg/ 'heart', /nalɑf/ 'fish', /sasʌ/ 'bad',
/manis/ 'sugar', /haʌ/ 'yes', /mɑhɑl/ 'different',
/mih/ 'sweet', /man/ 'say', /nam/ 'six',
/kumi/ 'hair (of face)', /kuni/ 'mildew',
/ñgà/ 'child', /bañgal/ 'floor girder', /sagiñg/ 'banana',
/likō/ 'fear', /falʌl/ 'hand',
/wak/ 'hair', /mawɑg/ 'far', /lanaw/ 'lake'
/yè/ 'mother', /kayo/ 'tree', /tukay/ 'small'

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[9] There is free variation between [d] and [r] alternants of this phoneme in intervocalic position in the speech of many speakers.
[gadʌ] or [garʌ] 'to know', [sudʌñg] or [surʌñg] 'to sit', [kudà] or [kurà] 'horse', [tadag] or [tarag] 'to stand', [kudañg] or [kurañg] 'sleep'.

[10] Glottal stop in word initial and intervocalic positions, for the sake of economy, and in line with Philippine National Language tradition, is not written. There are no vowel-initial words and no vowel clusters in the language. Such words as /akwanɑn/ 'right (hand)', are, therefore, actually [ˋakwanɑn].

[11] In two Spanish loans an allophone [p] has been observed: [pasinsya] (paciencia) 'excuse', and [patatas] 'potatoes.' Those speakers who have not had much outside contact use /f/, as [fasinsya] 'excuse', and [fatatas] 'potatoes'.

[12] It is necessary to write this phoneme as ñg instead of ng because, unlike many Philippine languages, there is contrast in this language between sequences /ng/, /ñgg/, and /ñg/. Examples: /san.gwas/ 'to play', /tmiñg.gal/ 'to shoot', /ni.ñgok/ 'to roll'.

SYLLABLE PATTERNS

The non-suspect syllable patterns are: CV /ba.lok/[13] 'rotten', CVC /ban.suñg/ 'knife', CCV /flɑ.fus/ 'morning', CCVC /snun.tuk/ 'to hit (with the fist)'.

INTERPRETATION

These patterns determine most of the decisions in the writing of /w/ vs. /u/ or /o/ and /y/ vs. /i/. However, additional strong support for interpreting some of these questionable segments as consonants rather than vowels is provided by the phenomenon that the vowel /a/[14] may precede any authentic consonant cluster in the world-initial position, while it does not have this freedom of occurrence before single initial consonants. The following examples show clearly the presence of a true initial consonant cluster because the /a/ is permissible. /kwanɑn/ or /akwanɑn/ 'right (hand)', /twali/ or /atwali/ 'younger brother', /twʌgʌ/ or /atwʌgʌ/ 'elder brother', /dyol/ or /adyol/ 'to pull', /myɑɑn/ or /amyɑɑn/ 'married', /syʌm/ or /asyʌm/ 'nine'.

VOWELS[15]

There are seven vowel phonemes:

Phoneme	Allophone	Description and occurrence
/i/	[ɩ]	High, open, front, unrounded vocoid. Occurs in syllables closed with consonants other than /ˀ/ or /h/. [kɩndî] 'jug'
	[i]	High, close, front, unrounded vocoid. Occurs elsewhere. [kumi] hair (of face)'
/e/	[ɛ]	Mid, open, front, unrounded vocoid. Occurs in syllables closed with consonants other than /ˀ/ or /h/. [mlalɛl] 'yellow'
	[e]	Mid, close, front, unrounded vocoid. Occurs elsewhere. [eɛl] 'water'
/ʌ/	[ɨ]	High, central, close, unrounded vocoid. Occurs in open syllables. [twɨgɨ] 'elder brother'
	[ʌ]	Mid, central, open, unrounded vocoid. Occurs elsewhere.

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[13] Period within a word in this paper indicates syllable division.

[14] All initial vowels are preceded by glottal stop. See footnote 3.

[15] Vowel length. Vowel length is not phonemic. However, the vowel in the first syllable of disyllabic words is often lengthened. [la:gi] or [lagi] 'male human', [lɑ:bun] or [lɑbun] 'cloud'.

[bʌklɑy] 'ankle bone'

/a/	[a]	Low, front, open, unrounded vocoid.
/u/	[u]	High, back, rounded vocoid.
/o/	[o]	Mid, back, rounded vocoid.
/ɑ/	[ɔ]	Low, back, close, rounded vocoid.

Realizing that many of the Philippine languages have a four vowel system, and some only three, we have made several attempts to reduce the number of our vowels. The most important of these attempts were to combine a with ɑ, and u with o. Due to the contrasts shown under the respective vowel comparisons to follow, it will be shown that this is not possible. It was even suggested that we check the possibility of intersection of ɑ with o and u. The following contrasts, however, show the difficulty of entertaining that suggestion.

	ɑ		o		u
/milɑh/	'to run'	/miloh/	'to deal'	/miluh/	'to serve'
/ilɑh/	'Blɑɑn plant'	/ilo/	'unhusked rice'	/iluh/	'ladle'
/kɑng/	'name of bird'	/ikong/	'tail'	/tikɔng/	'name of fish'
/mabɑl/	'wide'	/mabol/	'overripe'	/fabul/	'gift'
/tɑ/	'rice winnowings'	/to/	'person' 'we incl.'	/kutu/	'lice'

After /i/, /e/, and /ʌ/ had been combined with their allophones, as previously illustrated, the following contrasts were worked out by charting every remaining vowel comparison to prove the existence of the seven phonemes.

/i/ & /ʌ/	/ti n/	'stomach'	/tʌʌn/	'to see'
	/kumi/	'hair (of face)'	/limʌ/	'five'
/i/ & /e/	/mli/	'to buy'	/mle/	'to give'
	/tnii/	'little finger'	/tnee/	'rust'
/i/ & /u/	/tkilil/	'to lie down'	/kilul/	'saucer'
	/iluh/	'ladle'	/ulu/	'head'
	/kilʌt/	'lightning'	/kulit/	'skin'
/i/ & /o/	/di/	'particle'	/do/	'I' (1st per.sg.)
	/gami/	'we excl.'	/gamo/	'you pl.'
	/saif/	'to drown'	/gaol/	'shirt'
/i/ & /ɑ/	/bi/	'lady'	/bɑ̃/	'mouth'
	/fifi/	'cheek'	/fɑfɑk/	'wing'
/i/ & /ɑ/	/filʌ/	'how many'	/falʌ/	'plant'
	/magin/	'accompany'	/gmagan/	'able to', 'power'
/ʌ/ & /e/	/dʌʌ/	'many'	/dee/	'there'
	/dʌ́/	'more'	/lè/	'again'
/ʌ/ & /u/	/gʌ/	'you sg.'	/gu/	T

	/fitʌ/	'to show'	/fitu/	'seven'
/ʌ/ & /o/	/gitʌ/	'we dual'	/gito/	'we incl.'
	/bʌʌn/	'head basket carrier'	/doon/	'leaf'
/ʌ/ & /*a*/	/falʌ/	'plant'	/f*a*l*a*/	'shovel'
	/tʌʌn/	'to see'	/s*aa*l/	'floor'
/ʌ/ & /a/	/alwʌk/	'waves'	/alwak/	'tears'
	/mbʌl/	'open (as a plant)'	/mbal/	'to blow'
	/nsʌʔ/	'to peal'	/nsaʔ/	'to suck'
/e/ & /u/	/fè/	'sister-in-law of male' or 'brother-in-law of female'	/fù/	'grandmother'
	/mlalel/	'yellow'	/bulul/	'mountain'
/e/ & /o/	/tee/	'excrement'	/too/	'very'
	/kmahè/	'salty'	/kmahoñg/	'to swim'
/e/ & /*a*/	/lè/	'again'	/l*à*/	'not'
	/det/	'what'	/f*a*t/	'four'
/e/ & /a/	/bnè/	'seed'	/bnas/	'grass'
	/mle/	'to give'	/mlan/	'hen'
	/det/	'what'	/bat/	'to throw'

/u/ & /o/ NOTE:—There is considerable free fluctuation between u & o. However, because of the contrasts shown below, we feel forced to consider them as separate phonemes.

	/tlu/	'three'	/tlo/	'to call'
	/tuh/	'to sweat'	/toh/	'blackbird'
	/miluh/	'to serve'	/miloh/	'to deal'
	/iluh/	'ladle'	/ilo/	'unhusked rice'
	/tikuñg/	'name of fish'	/ikoñg/	'tail'
/u/ & /*a*/	/su*a*l/	'thorn'	/s*aa*l/	'floor'
	/iluh/	'ladle'	/il*a*h/	'Bl*aa*n plant'
	/miluh/	'to serve'	/mil*a*h/	'to run'
	/fufuñg/	'heart'	/f*a*f*a*k/	'wing'
	/tikuñg/	'name of fish'	/k*a*ñg/	'name of bird'
/u/ & /a/	/mut*à*/	'to vomit'	/mat*à*/	'unripe'
	/fulak/	'forehead'	/falak/	'sand'
/o/ & /*a*/	/miloh/	'to deal'	/mil*a*h/	'to run'
	/ilo/	'unhusked rice'	/il*a*h/	'Bl*aa*n plant'
	/ikoñg/	'tail'	/k*a*ñg/	'name of bird
	/lohok/	'rib'	/*a*h*a*k/	'planting stick'
	/doon/	'leaf'	/sd*aa*s/	'to fight'
/o/ & /a/	/balok/	'rotten'	/balak/	'to swell'
	/flalok/	'to sing'	/falak/	'sand'
/*a*/ & /a/	/w*a*k/	'crow'	/wak/	'hair'
	/bl*a*tik/	'snare'	/blatik/	'star'
	/nal*a*k/	'to hold'	/nalak/	'to kiss'
	/f*a*f*a*k/	'wing'	/falak/	'sand'
	/lal*a*ñg/	'bald'	/lañg/	'to snore'

STRESS

A primary stress normally occurs on the ultima of a word base and a secondary stress on the antepenult of polysyllabic words.[16]

mʌbʌ́ gʌ́ dó eél.	'bring you me water' (You bring me water.)
toó mlaán bukáy kudá ayé.	'very fast white horse that' (That is a very fast white horse.)
ayé gúmilʌ̂gu kifúh aní.	'that place to sleep mine night is' (That is my place to sleep tonight.)

DISTRIBUTION

CONSONANTS. In monosyllabic words: any consonant may occur initial or final. In polysyllabic words: any consonant may occur at the beginning of the first, second and third syllables. At the end of the first syllable all but /·/, /h/, /w/, and /y/ have been observed. At the end of the second syllable, any consonant may occur. At the end of the third all but /y/ have been observed. As there are very few four syllable words, only /d/, /f/, and /n/ have been observed at the beginning, and /·/ at the end of the fourth syllable.

CONSONANT CLUSTERS. Syllables containing consonant clusters are usually found word-initially only. /bla.tik/ 'star', /bnas/ 'grass', /bsol/ 'full', /btas/ 'value', /bwa.ya/ 'crócodile', /bya.o/ 'candlenut tree', /dma.sal/ 'pray', /dna.feñg/ 'skirt cloth', /dway/ 'one of many wives, /fdè/ 'to sting', /fka.gò/ 'to lean forward', /fla.fus/ 'morning', /fna.gʌs/ 'compulsion', /fñga.lo/ 'oil from coconut', /fsa.lam/ 'fire break", /ftud/ 'rest', /fyʌ/ 'good', /kdʌ.ʌ/ 'all', /kfo.on/ 'correct', /kla.kub/ 'shell of egg', /kma.hoñg/ 'to swim', /kna.yʌ/ 'to want', /ksaw/ 'roof poles', /kwa.nan/ 'right (hand)', /kyaf/ 'jump', /lba.tù/ 'log', /lfi.das/ 'boulder', /lkek/ 'kind of plant', /lman/ 'body odor', /lna.nʌb/ 'to clean', /ltè/ 'ant', /lwak/ 'tear', /lyak/ 'important', /mbal/ 'blow (as wind)', /mda.doñg/ 'near', /mfis/ 'fish fin', /mgu.lè/ 'alive', /mkaw/ 'to cough', /mla.lel/ 'yellow', /mna.ol/ 'descend', /mñga.lam/ 'deep', /msʌ/ 'to count', /mtʌ.tʌk/ 'fall', /myak/ 'up', /nbad/ 'bind up', /ndak/ 'to spear', /nfas/ 'to hit', /nsaf/ 'to suck', /ntam/ 'to burn',

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[16] When words are given in isolation, out of normal context, stress may vary.

/sba.law/ 'to quarrel', /sd*a*.*a*s/ 'to fight', /sdʌ́/ 'pig', /sfa.lò/ 'ten', /sga.toñg/ 'egg plant', /skuf/ 'handful', /sla.oñg/ 'hat', /sma.lʌk/ 'to ask,' /sna.fut/ 'wrap up', /stu-lʌn/ 'to speak', /sw*at*/ 'comb', /syʌm/ 'nine', /tba.k*a*l/ 'thumb', /tdò/ 'to teach', /tfò/ 'to break (wood)', /tluh/ 'straight', /tma.eñg/ 'honey bee', /tni.bʌh/ 'cut with bolo', /tki.lil/ 'to lie down', /tla.weñg/ 'to hang', /tmiñg.gal/ 'to shoot', /tna.lò/ 'finger', /twa.li/ 'younger sibling'. As stated previously, it is permissible to add the vowel /a/ preceding any initial consonant cluster, but not before single initial consonants. /gli.fʌt/ or /ag.li.fʌt 'to forget', /mñgʌl/ or /am.ñgʌl/ 'cry (weep)'. This permits an added initial syllable and puts potential syllable boundaries (C.C) between all initial (CC) clusters.

To date clusters within the syllable in positions other than initial have been observed in the following words only: /san.gwas/ 'to play', /gam.dyol/ 'able to pull', /fan.glut/ 'to believe'. (These three words are the only ones in which clusters of three consonants have been noted; one consonant to end a syllable and a cluster of two to begin the next.)

Clusters have also been observed between syllables. As this is quite common in many languages, only a few examples have been listed. /kam.nʌ/ 'strong', /bʌkl*a*y/ 'ankle bone', /fal.wà/ 'to take out'.

VOWELS. In both open and closed monosyllabic words all vowels may occur. In polysyllabic words all vowels have been observed in open and closed first, second and third syllables except for /e/ in closed first syllable. In the few fourth syllables only /a/ has been seen in open and /*a*/ and /u/ in closed syllables.

The particle /i/ is often slurred into the preceding and following words in rapid speech, but in slow speech it is always preceded by glottal stop.

SAMPLE TEXTS

ULAD NA UÑGEH
Snake and Rat

Satu du ulad na uñgeh. Man ulad kanʌ uñgeh, Snuke tagʌ
One day snake and rat. Said snake to rat, Pay I you
mimò gʌ do sol. Man uñgeh, Haʌ. Na makol uñgeh.
make you me hole. Said rat, Yes. And dig rat.
Kanto fñgʌ makol, uñgeh lamwâ fdu lam sol. Manan

When finish digging, rat go out from inside hole Said he
kan ulad, Tafñgʌ flanʌk. Man ulad, Nagu nʌyʌ muna.
to snake, Finished friend. Said snake, And I to see first.
Amdà ulad fusuk tù lam sol. Lamlon lè lamwà.
Go snake enter there inside hole. Shortly he again came out.
Manan kan uñgeh, Flanʌk, nun tukay gʌ là fñgʌn.
Said he to rat, Friend, there is little you not finished.
Na lè mdà uñgeh fusuk. Kanto tù lam, uñgeh, lalò
And again go rat enter. When there inside, rat, follow
ulad. Na flʌs naket ulad uñgeh. Na talà gulè
snake. And right away bite snake rat. And not return
uñgeh tafloh ulad.
rat swallow snake.

TUA LAGI NA I TUA LIBUN
old man and old woman

Atñganan nan afkudañg tukay ñgà lagi na klola mdà
At first let sleep little child boy and then they go
ambatun. Na tamukat tukay ñgà lagi. Atlon maan na
away. And wake up little child boy. Call Father his and
yean. Là talù yean na maan. Na kmadew.
mother his. Not speak mother his and father his. And cry (he).
Na salu dee tua libun busaw. Manan di kanʌn,
And come there old woman spirit. Said she to him,
Kan ku kmadew gʌ? Là tʌʌngu yè na mà.
Why do cry you? Not see I mother and father.
Tamanan, Do yeam. Taman ngà lagi, Magin tagʌ.
Said she, I mother yours. Said he child boy, Accompany I you.
Taman tua libun, Amdà atʌ. Na kanto alʌ mdadoñg
Said old woman, Go we. And when they near
na tabunin i tukay ñgà lagi di klifak sagiñg na
and hide she little child boy in stalk banana and
taflʌs di gumnʌan. Na tatamlo maan na yean. Atlola
directly to house hers. And called father his and mother his. Call they
tukay ñgà lagi. Na là tmimʌlan. Na fanñgabal
little child boy. And not answer he. And look
maan di gumnʌ tua libun busaw. Na tamanan, Là

father his in house old woman spirit. And said he, Not
dini ñgɑ̀gu? Taman tuɑ libun, Lɑ̀ dinin. Na kanto
here child mine? Said old woman, Not here he. And when
tabʌgamlo tatamlo tukay ñgɑ̀ lagi. Tamanan, ʌ yè,
after awhile called little child boy. Said he, O mother,
dinigu, ʌ mɑ̀, dinigu. Tamanan, Kan ku dini gʌ?
here I, O father, here I. Said he, Why here you?
Tamanan, tukay ñgɑ̀ lagi, Buni tuɑ libun agu. Na
Said he, little child boy, Hide old woman me. And
tanwʌan. Na Na tamanan di tuɑ libun, Kan ku nwʌam
get he. And said he to old woman, Why get you
tukay ñgɑ̀ lagi? Taman tuɑ libun, Anwʌ́gu du landʌ́
little child boy? Said old woman, Get I because no
dad dʌmʌn. Taman mɑan, Kan ku lɑ̂ tulʌnam do?
companions his. Said father his, Why not tell you me?
Aglifʌtgu. Kan ku bunim di klifɑk sagiñg? Bunigu du
Forget I. Why hide you in stalk bananas? Hide I because
taknɑɑn dad dʌmʌgu. Na mulé tuɑ lagi na ñgɑan tú
eat companions mine. And go home old man and child there
di gumnʌ́la.
to house theirs.

FREE TRANSLATION OF TEXTS

Snake and rat.—One day there was a snake and a rat. The snake said to the rat, "I will pay you if you make me a hole." The rat said, "Yes." So the rat dug. When the rat finished digging, he went out of the hole. He said to the snake, "I am finished, friend." The snake said, "I will go and see first." So the snake entered the hole. Shortly he came out. He said to the rat, "Friend, there is a little you have not finished." Again the rat went into the hole. When the rat was in, the snake followed him. Right away the snake bit the rat. The rat could not return because the snake swallowed him.

The old man and the old woman.—At first they let their little boy go to sleep and then they went away. When the little boy awoke, he called his Father and Mother. His Mother and Father did not answer and so he cried. Then the Old Spirit Woman went there. She said to him, "Why do you cry?" "Because I do not see my Mother and Father." She said, "I am your Mother." Said the little boy, "I will accompany you." The Old Spirit Woman said, "Let us go." When they were near, she hid the little boy in the banana stalk and went directly to her house. The Father and the Mother called him. They called their little boy. He did not answer. The father then looked in the house of the Old Spirit Woman. He said, "Is my child not here?" Said the Old Spirit Woman, "He is not here." All at once the little boy called. He said, "Mother, here I am, Father, here I am." His Father said, "Why are you here?" The little boy said, "The Old Spirit Woman hid me." So the Father got him. Then he said to the Old Spirit Woman, "Why did you get my little boy?" The Old Spirit Woman said, "I got him because he had no companion." The Father said, "Why didn't you tell us?" "I forgot." "Why did you hide him in the stalk of the banana?" "I hid him because my companions would eat him." Then the old man and his child went to their home.

BOW AND ARROW OF THE VISAYAN NEGRITOS

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SIX PLATES

INTRODUCTION

The following description of some bows and arrows of the Visayan Negritos is partly a supplement to an article entitled, "Negritos of Northern Negros," written by the same authors.[1] The discussion of the bows and arrows mentioned in that paper was reserved for a special publication. The specimens of the weapons were obtained in connection with ethnographic field work which the writers did in their brief vacation weeks among the Negritos of the Visayas during the period from December, 1954 until June, 1955. The small collection consist of altogether five bows and nineteen arrows. Two bows are from the Negritos of northern Negros: a long one with two arrows from *sitio* (hamlet) Bago; and a short one from Alasiis, for which two arrows were made upon order in sitio Gamot. The first two localities are sitios of San Carlos while the third is a sitio of Calatrava—both towns belonging to Negros Occidental. In the Province of Iloilo (Panay) two bows with eleven different arrows were acquired in Balud and Sianon of the town of Janiuay. Finally, one bow with four different arrows were secured from Negrito *herbolarios* (herb doctors) who lived temporarily in *barrio* (village) Kanduman, town of Mandawe, Cebu. These Negritos had come from the island of Panay for the purpose of collecting and selling medicinal plants.

It may be anticipated here that all the arrows acquired have no feathering.

USE OF BOW AND ARROW AMONG THE VISAYAN AËTAS

Bow and arrow play nowadays only a secondary role in the economic life of the Visayan Negritos. According to Negrito

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[1] The article will appear in one of the next issues of *Anthropos*.

herbolarios who were interviewed in Kanduman, Mandawe, Cebu, bow and arrow (they called the weapon *pana*) are used occasionally for fishing in creeks, for hunting big lizards (*halu* and *ibid*), and for defense. The same informants said that when they were once in Lanao in order to sell medicinal plants, they were ambushed by hostile Moros. However, when they saw the Negritos getting their bows ready for defense they ran away. The Atas of northern Negros have, as already stated, a longer and a shorter bow (both called *pana*) and different kinds of arrows (*baluong*). The longer bow is used for hunting big game such as wild pigs (*ihalas na baboy* or *bakatin*) and deer (*lagsaw* or *osa*), the shorter for shooting fish and birds. The Atis of Janiuay, Iloilo, use bow and arrow chiefly to hunt the big lizards *halu* and *ibid*, two kinds of wild cats called *singalong* and *milo*, wild pig (*baboy nga talunon*), and deer (*osa*). They furthermore use it as a weapon of defense. Occasionally they sell bows and arrows to the Christians who use them for the same purpose as the Atis.

DESCRIPTION OF THE BOWS AND ARROWS ACQUIRED

The bows and arrows of northern Negros.—The bows obtained from northern Negros (Negros Occidental) are made of the body of the *anaháw* (palma brava, *Livistona* sp.) A matured tree is felled and the trunk cut into lengths of proper size. These are later split into pieces which are about five centimeters thick. With a sharp *guna* (machete) the wood is shaped into the rough form of a bow shaft. This rough form is then smoothed with the edge of a splint of a bamboo-variety called *bagakay*. The *bagakay* splint is pushed back and forth on the shaft until the surface is even.

The cross section of the bows is that of an isosceles triangle with rounded base angles, while the apex angle remains emphasized as a sharp ridge. This portion of the bow (its belly) faces the bowman when he draws the bow. The length of the shorter bow is 164.5 centimeters, while that of the longer is 196.5 centimeters. The width of the two bow shafts at their center is two centimeters. At each end of the two bow shafts is a spur, the base of which is notched to receive the bowstring. Near the notch is wound a twisted chord of *banlot* (bast fibers of the roots of the young *baléte* tree, *Ficus* sp.), which is about four-tenths of a centimeter thick. The winding around the edge of the notched area which begins near the notch and is about two and half centimeters long strengthens the base of the notch. It keeps the bow shaft from splitting at this point, since this small part bears a good amount of the tension when the bow is drawn.

The strings of the two bows are made of a strip of rattan called *payasan* (*Calamus Merrillii* Becc.); they are ten centimeters shorter than the bow staff. The cross section of each string is flat-oval, and it is about four-tenths of a centimeter wide. At each end (of the bowstring) is attached a loop which is about two and a half centimeters in diameter when drawn into a circle. These loops (one on each end of the bowstring) are made of *banlot* cord which is from four-tenths to six-tenths of a centimeter thick. The loops are fastened permanently to the ends of the bowstring, the latter reaching the edge of the loops. The winding that holds the loop to the bowstring extends from fifteen to twenty centimeters towards the latter's center. When not used the bow is unstrung.[2] In stringing it one end of it is braced against the ground. The middle part (the belly of the bow facing the bowman) is held between the large and the next toe of one of the feet. The upper part of the bow is held by the left hand below the base of the spur. Slowly, and with a gentle but firm pressure, the foot pushes the bow until the bowstring can be slipped into the notch at the base of the spur. For a Negrito this is a simple task, but for a "layman" it is rather complicated matter. In fact, they smiled at the efforts of Maceda and one of the porters who tried to string the bow. To fit an arrow is not a simple task either, and to draw the bow is even more difficult. The arrow is held between the index and the middle fingers of the right hand at the level of the second joints; at the same time these two fingers and the ring finger are hooked to the bowstring. The left hand holds the bow exactly at its center; at the same time the proximal portion of the arrow (just below the base of the arrow head) is held loosely against the bow staff by the index finger. The bow is drawn with a slow but firm pull and the arrow pointed towards the target. According to the Atas, one must practice constantly to be proficient in the use of the bow and arrow. If the procedure in drawing the bow is wrong, the bowstring easily splits. At twenty paces the unfeathered arrow shot by Ostoy, an Ata from Bago from whom we obtained the longer bow, went through two banana trunks each of about thirty centimeters in diameter.

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[2] The Negritos of northern Luzon keep their bow "always strung, and the string is never taken off, except when they want to replace either bow or string" (Vanoverbergh, "Negritos of Northern Luzon," p. 414).

The Atas of Bago use arrows that have an over-all length (including the arrow point) of 165 centimeters for hunting big game, *i.e.* deer and wild pig.[3] The arrow is composed of two main parts, the arrow shaft, made of *gusa* (a kind of reed), which is 142 centimeters long and his six-tenths of a centimeter in diameter at the place where the arrow point is attached. The diameter gradually diminishes towards the distal end where there is a notch for the bowstring. At the proximal end the shaft is provided with a cavity four centimeters deep, to receive the detachable arrow point. The cavity is diamond in shape. Its outer part is strengthened by winding around it from the joint towards the center of the shaft, a thin strip of rattan (two-tenths of a centimeter wide) to a length of about two centimeters. The arrow point from Bago is made of the already mentioned bamboo-variety which is called *bagakay* in Visayan. The point is twenty centimeters long and lanceolate in shape. It has no barbs. The arrow point from Gamot (the two specimens have identical chapes) is thirteen centimeters long. It has a barb (*salait*) on one side. The point from Bago is made of matured bamboo, whereas the one from Gamot is one of *anibong* (*Oncosperma horrida* Schef.). Due to the good material their edges remain sharp.

Bows and arrows of Janiuay, Iloilo, Panay.—From Janiuay, Iloilo, two bows (*busogan*) with eleven arrows (*baslay*) were obtained. The bows are made of the wood of *palma brava.*

One of the two bows is 154.5 and the other 146 centimeters long. The bow shafts are rectangular in cross section and somewhat flat-oval. The shaft of the longer bow has a cross-section width of three and a half centimeters, and a cross-section height of one and a half centimeters. The respective measures of the shorter bow shaft are three centimeters by one centimeter. On each end of the bow shaft projects a spur for the bowstring. The stringing and unstringing are done in the same way as in the case of the bows from northern Negros, except in the last step in which the bowstring is simply shortened or loosened, because on one side it does not have a fixed loop. The Janiuay bowstring is made of the bast fibers of *banlot* (*Ficus* sp.).

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[3] Due to complicated transportation conditions the point of one of the two (identical) arrows was unfortunately lost on the way back to Cebu City.

Four kinds of arrows (*baslay*) were obtained together with the two bows. The length of the arrow shafts (without the point) ranges from 126 to 130 centimeters, while the points are from thirteen to twenty centimeters long. Two arrow points (*sinagupit*) have barbs on both sides, while the third has a foreshaft (*binurong*) to which the arrow point (without barb) is attached, and the fourth arrow point is simply a lanceolate pointed piece of *tapikan* (*palma brava*) having a width of eight-tenths of a centimeter. The shafts are made of a small kind of bamboo. The nodes are strengthened with small strips of *nito* [*Lygodium circinnatum* (Burm.) Swartz] wound around them to a length of five to six centimeters.

Bow and arrows from Kanduman, Mandawe, Cebu.—The bow obtained from the Negrito herb doctors temporarily living in Kanduman, Mandawe, Cebu, is made of a variety of bamboo (*Bambusa spinosa* Roxb.). The length of the bow staff is 137 centimeters. Its cross section is rectangular in shape with the corners rounded. It is four centimeters wide at its middle part. It gradually tapers towards both ends till they are only two and half centimeters wide. The back of the bamboo is cleaned and the internodes in its belly are smoothened. On each end of the bow staff is a spur. The length of the two spurs is not the same. The one to which the bowstring is tied permanently, is shorter than the opposite spur around which the bowstring is lengthened and shortened as desired. The stringing and unstringing of the bow are done in the same way as in the case of the bows from Iloilo. The bowstring is made of *banlot* (*Ficus* sp.).

The arrows for the bow are of four kinds. Their lengths are more or less the same—about 100 to 110 centimeters. They have an average diameter of one centimeter. The distal end is notched for the bowstring. The outer part of the socket of the shaft that receives the arrow point is strengthened by winding around it a strip of *nito* or a small string, that usually extends from two to three centimeters towards the center of the arrow. Three of the four arrows acquired are of the harpoon type. The arrow points are connected with the shaft by a piece of string. The first arrow point (made of *sibucaw*, a kind of wood) has three sets of parallel barbs, spaced at two centimeters, the first pair being four centimeters from the tip of the point. The second arrow point, also of the same material, has only one pair of barbs. The third arrow point is made of iron wire. It is about four-tenths of a centimeter thick, and seven centimeters long. It has only one barb which is located about three centimeters from the tip of the arrow head. The fourth arrow has a foreshaft which is thirteen centimeters long, eight centimeters of which project after its base has been inserted into the cavity of the arrow shaft. The place of insertion is strengthened by winding around it a *nito* [*Lygodium circinnatum* (Burm.) Swartz] strip. The foreshaft is one centimeter wide; it is a little thinner at the end which is inserted into its base. The junction is strengthened again by winding around it a *nito* (*Lygodium* sp.) strip for a length of two centimeters. The arrow head has two edges that meet in an acute angle. This type of arrow point is detached as soon as it hits the animal and it remains in the body thereby slowing down the animals's escape.

VARIA

The actual use of bow and arrow.—The actual use of the bow and arrow has been mentioned above. According to Schebesta, the Atas of Negros are the only Negrito group that do not use bow and arrow any longer. The explorer writes in his work on the Negritos of Asia that the Atas have adopted the spear of their (pagan) neighbors, the Bukidnons.[4] However, Schebesta's statement must be restricted to the Ata-Bukidnon mestizos of the hinterland of Bais, southern Negros, whom he visited in 1939.[5] In northern Negros the use of bow and arrow has, as stated, not yet completely disappeared.

But there is probably one exception. It seems that the Mamanua Negritos of northeastern Mindanao have definitely given up the use of bow and arrow. The senior author and his associate, Marcelino N. Maceda, visited the entire region around Lake Mainit. Nowhere was the weapon used. Moreover, the writers are inclined to assume that also the Mamanua groups which they did not visit do not have it anymore. However, it must be remarked here that Generoso S. Maceda who, in 1938, did field work among the Mamanuas of Surigao mentions the bow as one of their weapons.[6] The Mamanua culture seems to be changing at a rather rapid pace, but it is possible that the bow is even now sporadically used among groups which live along the eastern coast of Surigao. One thing is certain: the former use of bow and arrow by the Mamanuas cannot be doubted. Garvan who was in northeastern Mindanao during the first decade of this century states that "their weapons are bows and arrows, lances, daggers, and bolos." He calls them "quite expert" in the use of bow and arrow.[7] Bow and arrow play a role in Mamanua mythology. Andres, a Mamanua of Mayag, Sison, Surigao, told the two writers a legend, in which Kabang, an evil spirit, was killed by seven Mamanua archers. The same story was told to them in Magtiaco, Kitcharao, Jabonga, Agusan, by a Mamanua named Jesus. Anday, an old Negrita from the environs of Matinaw, Mainit, Surigao, who was interviewed by the writers in October, 1954, vaguely remembered the use of bow and arrow by her people.

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[4] Schebesta, Pt. I 2: 70

[5] Schebesta, I, 64.

Material of bows.—As concerns the material of the Panay bows, Father Schebesta points out discrepancy between Reed and Gloria.[8] The former states that the Negritos of Panay "generally use a bamboo bow, much shorter and clumsier than those of *palma brava.*"[9] The bow acquired by Father Gloria is, however, of palm wood.[10] Schebesta thinks that Reed's and Gloria's bows come from different regions. The use of these two different materials is actually confirmed by the collection acquired by the writers of this paper. For the two bows obtained in Janiuay, where also Father Gloria collected his bow and arrows, are of palm wood, while the one acquired from the Negrito *herbolarios* who had come from Panay to Cebu is of bamboo. But perhaps the difference is not primarily one of regions. Marcelino M. Maceda was told by the Negritos of Janiuay that they prefer palm wood to bamboo when the former is available.

Arrow quivers and arrow poisoning.—Arrow poisoning and the use of quivers were not found among the Negritos from whom the specimens were obtained. They simply carry, bundled in their hand, the number of arrows they are going to use on a certain hunt. Schebesta arrives in his analysis of the bows and arrows of the Aëtas [11] at an interesting conclusion; namely, that where poisoned arrows are used also quivers (or covers of the arrows) occur. This holds good also for the Negritos of the Malay peninsula.[12] Gloria mentions in his article that the Atis of Janiuay use poisoned arrows against thieves.[13] However, when the second writer visited Janiuay, the Negritos there told him that they do not poison their arrows. The differences of time and groups may explain the discrepancy. The writers asked Father Gloria, when they were in Iloilo in June, 1955, whether he had seen quivers used by the Atis; he answered in the negative.

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[6] Maceda, p. 11.

[7] Garvan, pp. 4 f.

[8] Schebesta, Pt. I 2: 70.

[9] Reed, p. 43.

[10] Gloria, p. 96.

Collections of Aëta bows and arrows.—Several collections of Aëta bows and arrows exist. A collection acquired by Schebesta is in the Museo Missionario Etnologico in the Lateran Palace, Rome, and is composed of the following pieces: (1) Baluga Aëtas (eastern Luzon), three bows and six arrows; (2) Hambai Aëtas (Zambales, Tarlac, Pampanga, Bataan), eight bows and thirty arrows: (3) Manidé (Camarines Norte), four bows, eight arrows, and one arrow cover.[14] In the Department of Anthropology of the Catholic University, Washington, D. C., there are three arrows and one bow presented to the department by Father Gloria.[15] Father Vanoverbergh states that he shipped, besides other ethnological objects, part of his bow-and-arrow collection to the Lateran Museum in Rome and the rest to the Catholic University of America.[16] Two bows and thirty-two arrows, collected by Fox during his field work among the Pinatubo Negritos,[17] are part of the ethnological collection of the National Museum, Manila.[18] The Museum possesses a goodly number of other Philippine bows and arrows. The whole collection will soon be briefly described in a special paper. A collection of ten to twelve excellent bows and of about sixty assorted arrows of all types existed in the Museum and Institute of Archaeology and Ethnology, Manila. Unfortunately this collection was completely lost during the second World War.[19] The bows and arrows described in this paper belong to the University of San Carlos, Cebu City.

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[11] Schebesta, Pt. I 2: 70–84.

[12] *Ibid.*, p. 77. The Negritos of Northern Luzon do not have (real) quivers for their poisoned arrows. But they occasionally stick such arrows into a section of bamboo. See Vanoverbergh, "Negritos of Northern Luzon," pp. 414 f.

[13] Gloria, *loc. cit.* Manzano (see References), writing in 1937, likewise mentions the poisoning of arrows by the Panay Negritos.

[14] Schebesta, Pt. I 2: 72–77.

[15] Gloria, *loc. cit.*

[16] Vanoverbergh, "Negritos of Northern Luzon Again," pp. 28, 38; *cf.* pp. 10–36 *passim.* Father Vanoverbergh describes the bows and arrows of the Negrito groups studied by him, in: "Negritos of Northern Luzon," pp. 414 f.; "Negritos of Northern Luzon Again," 24: pp. 66–69; "Negritos of Eastern Luzon," pp. 924 f.

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VANOVERBERGH, MORICE, C.I.C.M. Negritos of Eastern Luzon. Anthropos 32 (1937) 905–928; 33 (1938) 119–164.

[17] Fox, "The Pinatubo Negritos," pp. 261–276. Fox did his field work among the Pinatubo Negritos in 1947–48.

[18] Information by Dr. Eduardo Quisumbing, Director of the National Museum, Manila.

[19] Information by Professor H. Otley Beyer, Director of the Institute and Museum of Archaeology and Ethnology, Manila.

ILLUSTRATIONS

PLATE 1

FIG. 1. Arrows from Janiuay, Iloilo.
2. A close up of the four arrows from Janiuay, Iloilo.

PLATE 2

FIG. 1. Bows from Janiuay, Iloilo.

PLATE 3

FIG. 1. Front view of the bow from Kanduman, Mandawe, Cebu.
2. Arrows from Kanduman, Mandawe, Cebu.
3. Harpoon type of arrows from Kanduman, Mandawe, Cebu.

PLATE 4

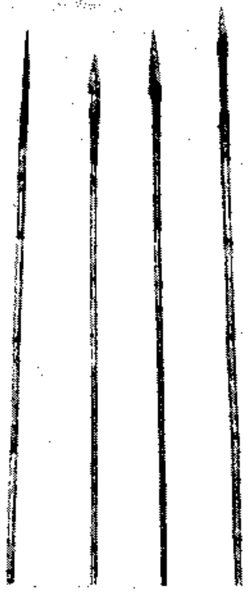
FIG. 1. Stringed bows from northern Negros.
2. Upper ends of the bows from northern Negros.

PLATE 5

FIG. 1. Bows from northern Negros.
2. Arrows from northern Negros.

PLATE 6

FIG. 1. An Ati drawing his bow.



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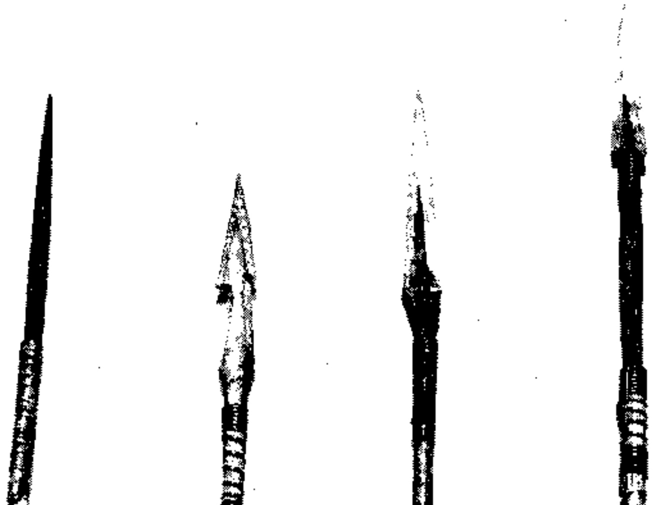

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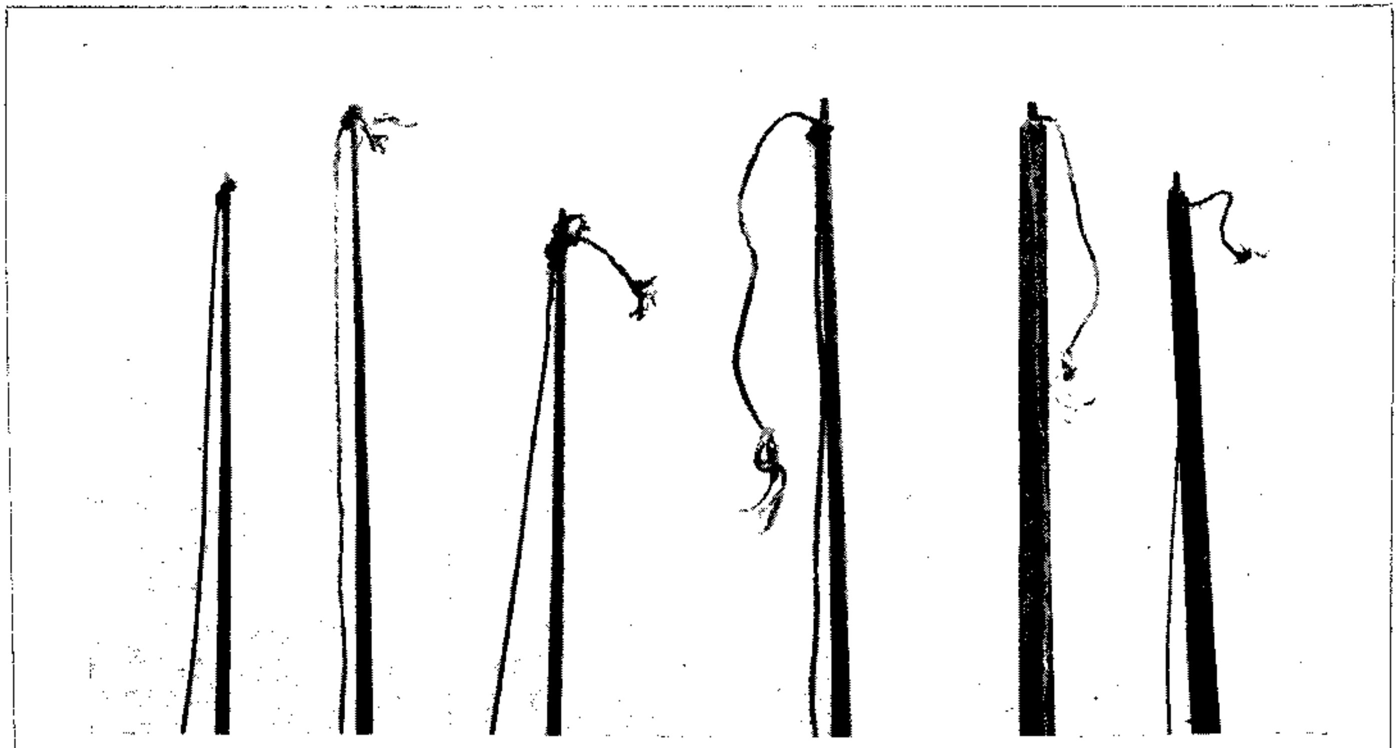

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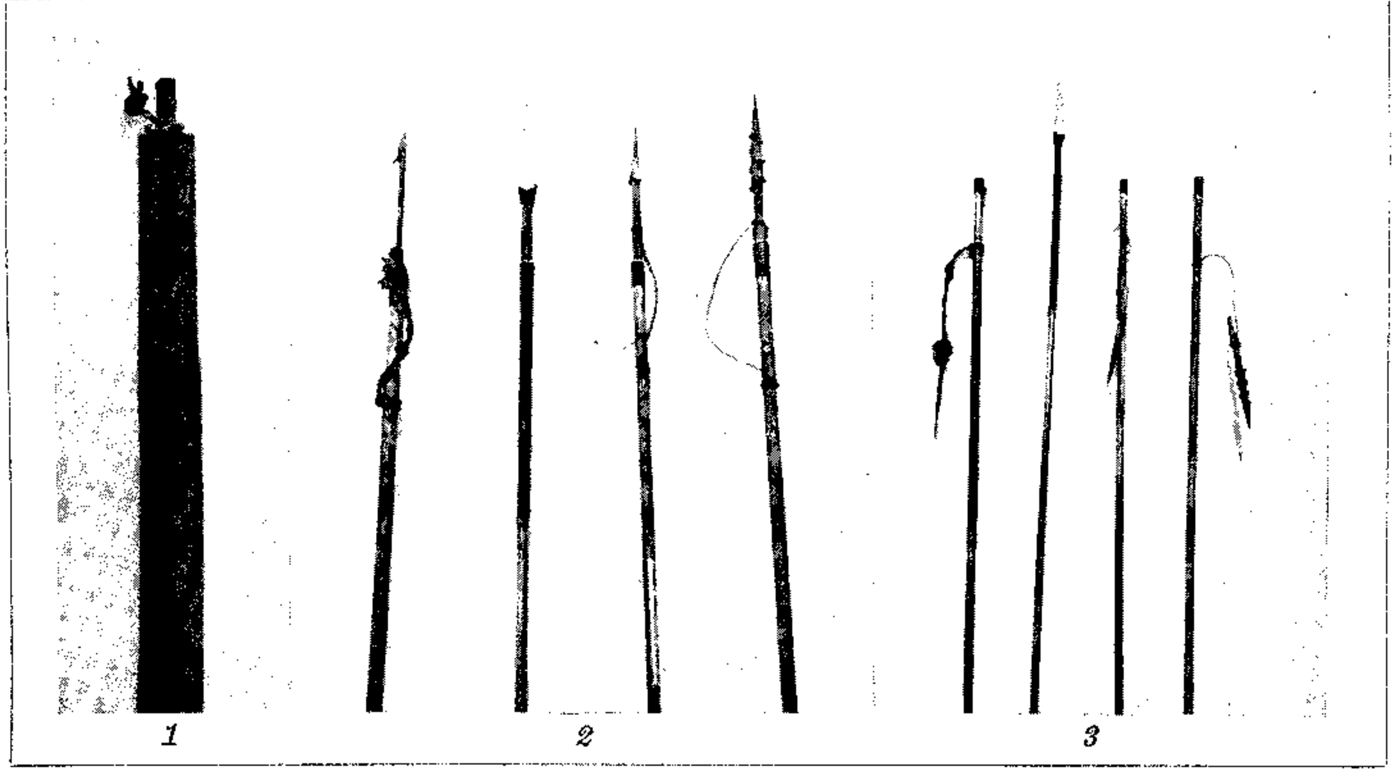

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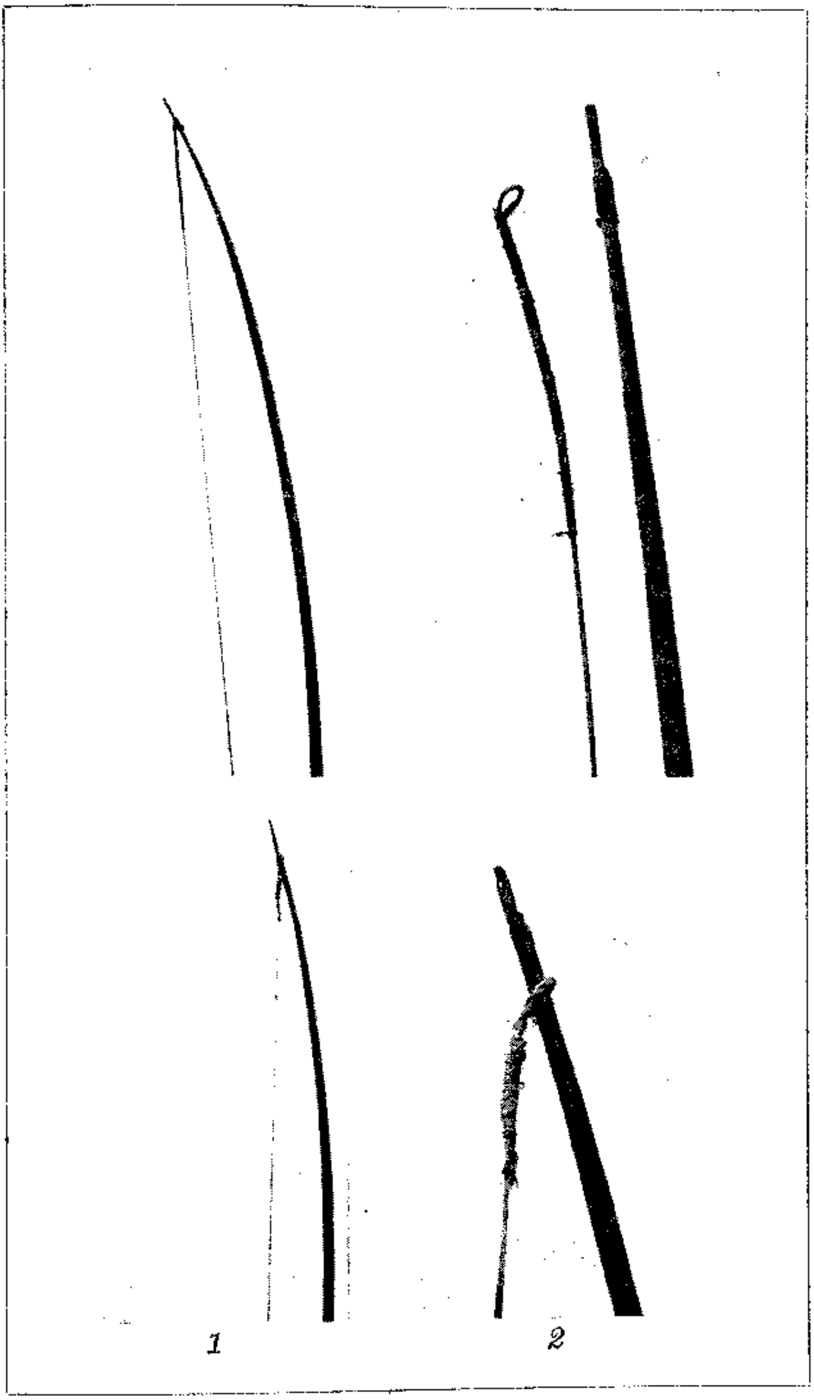

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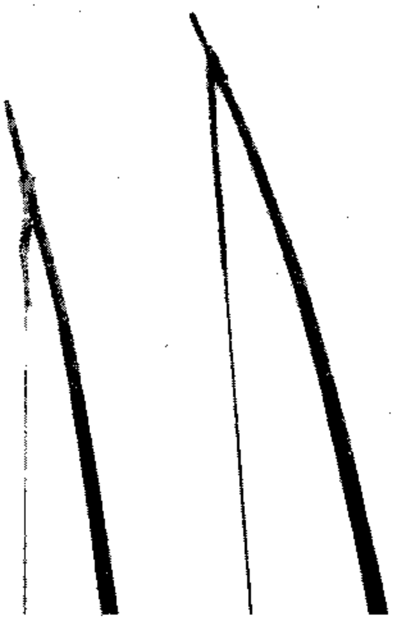

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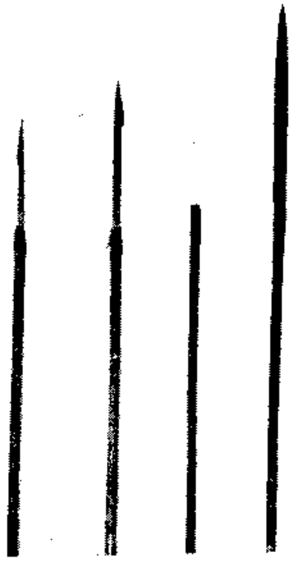

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PLATE 5.

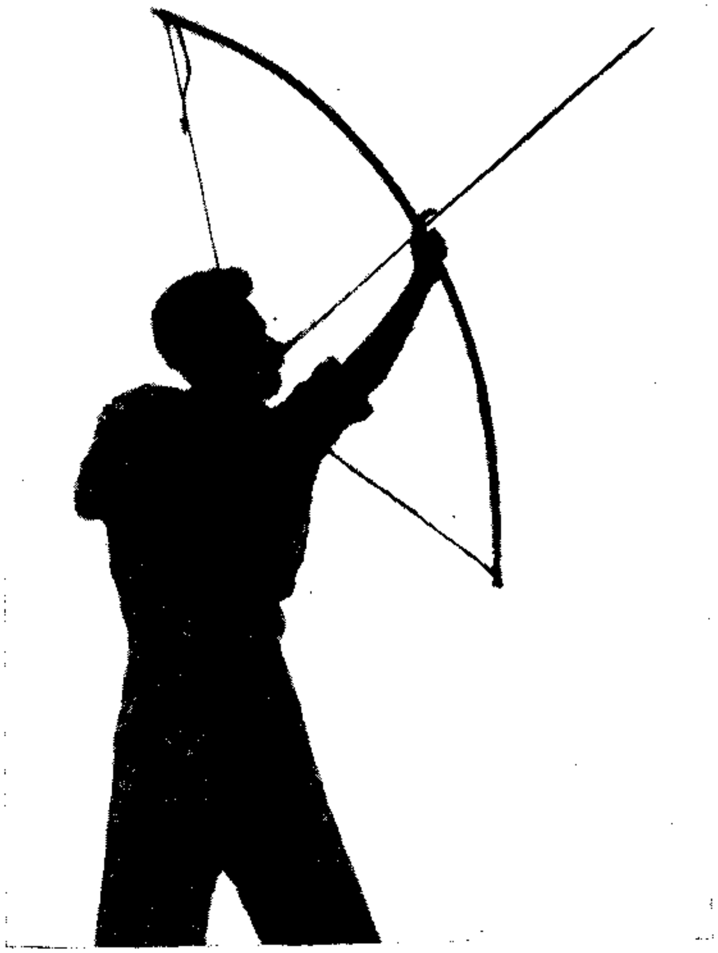

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PLATE 6.

RECTIFICATION OF OSCARELLA MALABONENSIS, A SPONGIOMORPHIC MASS FORMED BY MYRIAD OF TINY ANIMALS, MOSTLY TUBE-DWELLING AMPHIPODS, POLYCHÆTES AND TURBELLARIANS

By JOSE S. DOMANTAY
Bureau of Fisheries, Manila

ONE PLATE

INTRODUCTION

The *Oscarella malabonensis* reported in 1953[1] as a new species of askeletal sponge was further studied by the writer. Samples of the same material were collected at different times and parts of the year, and studied thoroughly with particular emphasis on the different animals associated with them. These samples taken from different habitats in the same locality showed some differences in their transient faunal composition and life existence. Although in general the form and color were more or less constant, resembling a black sponge, the above observations have given the writer a good reason to speculate on the identity of the said organism. After considerable study and investigation, he is fully convinced that the spongiomorphic mass is simply a conglomeration of siliceous and horny tubes cemented together by the secretion of the animals forming the mass. This paper rectifies the previous report on the subject.

STRUCTURAL COMPOSITION

The dried mass appears like a regular sponge loaded with siliceous mud with irregular lamellæ and numerous perforations. In between the distal tips of the lamellæ are the larger openings which give the mass a honey-comb appearance. Here the small anemones and polychætes dwell. In the lamellar walls are numerous tiny perforations which apparently are the dwelling places of the *Corophium shoemakeri* Monod, a tube-dwelling amphipod and the turbellarians, tiny triclad flat worms. The fresh material does not show any structure that can be considered as spicule or skeleton if it were a sponge. In its dried form however, it shows numerous fibers and bundles of rods which easily dissolved in water. With all these structures it resembles the texture of a regular sponge.

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[1] Philippine Bureau of Fisheries. Philippine fisheries; a handbook (Manila, 1953) 153–156.

CHEMICAL COMPOSITION

Oven dried materials of the spongiomorphic mass have been analyzed in the Chemical Laboratory of the Dagatdagatan Salt-Water Fishery Experimental Station. The following shows the chemical composition of the mass:

Nitrogen	Calcium	Silica	Phosphorus
Per cent	*Per cent*	*Per cent*	*Per cent*
0.14	0.72	41.12	0.19

The main portion of the mass is found to be siliceous material derived from the sandy-mud of the place, cemented to the numerous tiny tubes of animals by the slimy secretion of the turbellarians. The protein content of the mass may have been derived from the animal life associated with it. The low content of protein, however, 0.88 per cent may be explained by the escape of the majority of the animals from the mass before drying. Practically all the *Corophium shoemakeri* Monod, and the turbellarians escaped from the spongiomorphic mass when left overnight in a basin.

The high silica content and the low nitrogen and calcium contents of the spongiomorphic mass confirm the later finding that it is not a sponge. Usually a sponge based from the loggerhead specimen shows 7.45 per cent nitrogen or a protein content of 47 per cent.

FAUNAL COMPOSITION

The spongiomorphic mass taken from the bottom of the lagoon sheltered innumerable tiny animals. The majority of them constitute the *Corophium shoemakeri* Monod, a new species of a tube-dwelling amphipod which is described by Dr. Th. Monod, Director of the Institute Francais d'Afrique Noire. Together with the amphipods are numerous small turbellarians of undetermined species characterized by the absence of auricular lobes. The two animals constitute the bulk of the faunal composition of the mass. With them are some apparently transient inhabitants, a tiny species of gastropod, a tiny round worm, a free-living polychæte of the family Nereidæ, etc.

The mass taken from the concrete sides of the main water control gate of the pond system and another from the bamboo posts of the bridge across the lagoon of the Dagatdagatan Salt-Water Fishery Experimental Station at Malabon, Rizal, Philippines, show similarity in the basic faunal composition but they differ in the transient forms. The tube-dwelling amphipods and the turbellarians comprise the bulk as in those that were taken from the bottom of the lagoon. The transient forms are represented by small anemones resembling *Edwardsia*, species of polychæte worms resembling the *Sabella* and *Serpulla*, species of *Bougainvillea*, *Obelia*, and an undetermined genus, a species of a tiny Nudibranch which are not found in the other habitat. Associated with the hydroids are *Bowerbankia gracilis aggregata*, a ctenostome, and a new species of entoproct bryozoa which is being described by Dr. John D. Soule, a former colleague in the Allan Hancock Foundation, University of Southern California.

ACKNOWLEDGEMENT

The writer is very grateful to Dr. Deogracias V. Villadolid, Director of Fisheries, for the encouragement he gave the writer in undertaking researches at the Biological Research Laboratory of the Bureau of Fisheries, and to the following colleagues and friends who have helped him in many ways in this particular paper: Dr. Jerry Barnard, a former colleague at the Allan Hancock Foundation, University of Southern California; Dr. Th. Monod, Director of the Institute Francais d'Afrique Noire, who corresponded with the writer about the spongiomorphic mass and the habitat of the *Corophium shoemakeri* Monod, a tube-dwelling amphipod; Dr. John D. Soule, also a former colleague at the Foundation who checked up the identification of the ctenostome and entoproct bryozoans associated with the hydroids occasionally found in the spongiomorphic mass; Mr. Andres M. Mane, Superintendent of the Philippine Institute of Fisheries Technology for the facilities he extended the writer, particularly for the services of the scientific illustrator of the Institute; Mr. Herminio R. Rabanal, a colleague in the Bureau of Fisheries, for going over this paper; Miss Regina San Juan of the Chemical Laboratory of the Dagatdagatan Salt-Water Fishery Experimental Station for analyzing the chemical composition of the spongiomorphic mass; and Mr. Baldomero V. Escuadro, scientific illustrator of the Philippine Institute of Fisheries Technology, who made the illustration.

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ILLUSTRATION

Plate 1. Actual drawing from a dried specimen slightly enlarged. A small portion of the spongiomorphic mass showing the irregular lamellæ and the larger openings between their distal tips, and the numerous tiny perforations in the lamellar walls.

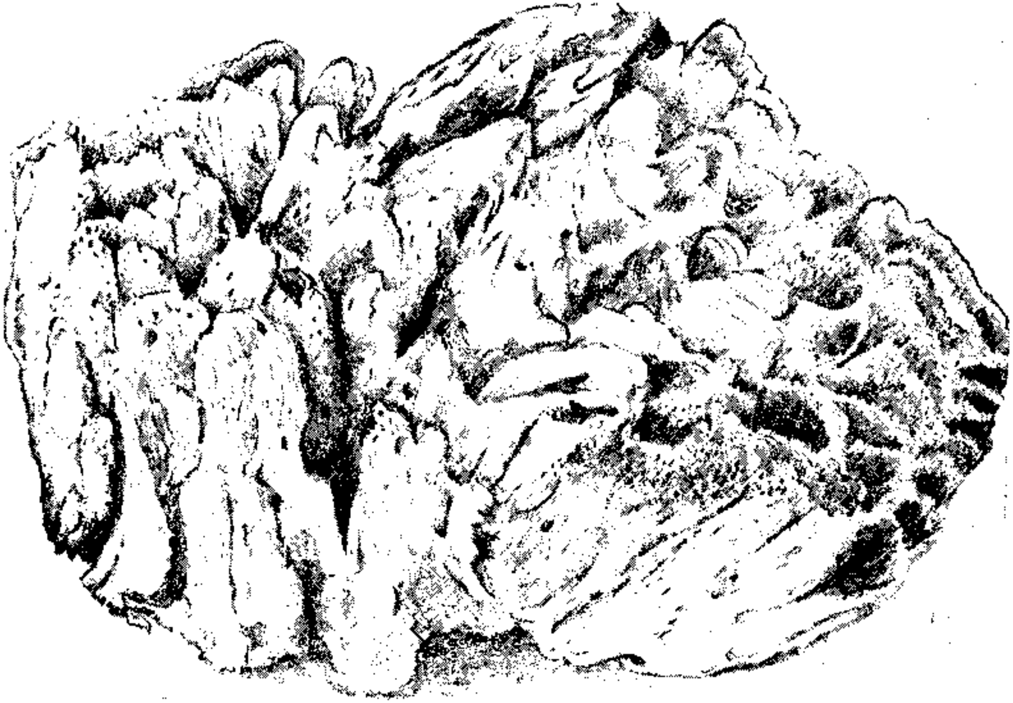

PLATE 1.

COMPOSITION OF PHILIPPINE FOODS, IV

By Carmen Ll. Intengan, Isabel Concepcion, Leon G. Alejo, Velona A. Corpus, Rosita D. Salud, Isabel del Rosario, Rosario Gomez, and Jesusa Henson
Institute of Nutrition, Manila

Two previous reports on the composition of Philippine foods (1953, 1954) gave the nutrient values of 275 samples of indigenous food plants and food products. The present paper is a report on the analyses of 124 food samples most of which were not included in the previous publications. These include 19 rice and rice products, 5 wheat and wheat products, 6 corn and corn products, 4 starches, 7 sugars and syrups, 16 pulses, nuts and seeds, 16 leafy vegetables, 3 seaweeds, 3 flowers, 2 shoots and stems, 22 fruits, and 21 analyses of egg samples.

Some of the samples of fruits and vegetables reported are grown only in certain regions of the Philippines. A sample of marang came from Cotabato and another from Zamboanga; the "durian" sample was from Davao. These were shipped by air-liner to our laboratory in Manila. Other samples came from the provinces of Laguna, Quezon, Bulacan, Albay, and Ilocos. The rest of the samples were purchased from the markets of Manila. Many of the fruits and vegetables reported in this paper are not popularly used nor commonly found in the markets.

The same methods of sampling, stabilizing and analysis as those reported in the first two papers of this series were followed in this report. Samples were usually purchased early in the morning on the first day of the week. Those from nearby provinces may have been gathered one or two days before sending them to the laboratory. For dry samples like rice, corn and wheat products, the samples were ground in a coffee mill before analysis and stored in amber-colored bottles with plastic covers. The stabilizing of the samples were completed on the day the samples were received. (A minimum of six samples were analyzed in a week).

RICE AND RICE PRODUCTS

Rice (*Bigas*).—Many varieties of rice, usually polished, are sold in the local markets. These varieties are used as staple food with the exception of "pirurutong" or the black colored rice, and the glutinous rice. The latter is used mainly in the preparation of desserts like rice cakes, "palitaw," "suman" and other snacks. The black colored rice is used principally in coloring rice preparations as "puto bumbong." The different varieties reported gave a range of nutrient values.

NOODLE (*Bihon*).—This is prepared by grinding in a millstone to a fine liquid suspension rice grains which have been washed and soaked overnight in water. After draining for 24 hours in linen bags, the rice dough is kneaded by hand or machine until homogeneous and plastic. The mass is made into balls and then pressed through small round holes of a metal box. The extruded filaments are dropped into a vessel of boiling water. The filaments are collected, arranged and spread on bamboo frames to dry under the sun. When dried the product is ready for the market. It resembles macaroni except that it is whiter and smaller in diameter.

RICE POLISHINGS (*Darak*).—The first two samples came from the Bureau of Plant Industry and from Guiguinto, Bulacan. These are finer and more fresh than the third sample which came from the Bureau of Animal Industry and was intended for animal feed.

VERMICELLI (*Pideos*).—Its preparation is similar to that of "bihon" except that glutinous rice is used and artificial yellow coloring is added.

NOODLE (*Sutanghon*).—This noodle is said to be prepared from rice flour in a manner similar to the preparation of "bihon." "Sutanghon" which is white and crinkly, is not produced locally. It is opaque when raw, but translucent when cooked.

WHEAT AND WHEAT PRODUCTS

Macaroni.—This is invariably manufactured from durum or common wheat flour. Egg proteins usually act as binder and impart the pleasing yellow color to the finished product. The sample reported is produced locally.

NOODLE (*Mique*).—This is produced from wheat flour dough. The dough is made saline with 1 to 3 per cent salt water. Alkali is added to make it golden yellow. The dough is flattened, cut into strips, boiled for 2 to 3 hours and dried under the sun. The "mique" Canton sampled here is sold in the market partly fried.

NOODLE (*Misua*).—This is also prepared from wheat flour like the mique but no alkali is added. The dough is stretched into fine long strings resembling vermicelli. These strings are dried under the sun.

CORN AND CORN PRODUCTS

CORN (*Mais*).—This is a staple food in certain sections of the Philippines where the supply of rice is limited. In other sections corn is used for animal feed only. The young corn (on the cob) is relished boiled or roasted over live coal. It may also be prepared as dessert with coconut milk, shredded coconut, in the form of "suman," pop-corn, "ampaw," or sweetened and used in ice cream and sherbet (usually "ice-drop") preparations.

STARCHES

CASSAVA FLOUR (*Kamoteng kahoy, arina*).—Three samples of cassava flour obtained from the Bureau of Plant Industry and commercial cassava grits from Malabang, Lanao, were analyzed.

SUGARS AND SYRUPS

SUGAR CANE (*Tubo*).—Sugar cane is cultivated throughout the Philippines, being one of the archipelago's major crops. It is a large, coarse, erect grass, with solid, yellow, green, or purplish stem 1½ to 4 m high and 2 to 5 cm thick. A sample of commercial sugar cane juice was analyzed. Likewise, local preparations of crude sugar as "panotsa," "matamis na bao," and "pakaskas" as well as samples of second, third, and fourth classes of refined sugar were also analyzed.

PULSES, NUTS AND SEEDS

RED KIDNEY BEANS (*Abitsuwelas*).—Analysis of kidney beans has been included in a previous paper but the beans reported here are grown locally. Bountiful beans are slightly smaller in size than the former. Both samples came from the Bureau of Plant Industry.

SOYBEAN (*Balatong*).—The values reported are averages of determinations from the three soybean samples submitted by the Bureau of Plant Industry for analysis.

LOTUS (*Baino*).—This plant is found wild in Laguna de Bay, particularly in the regions near Santa Cruz and Lumbang. It is a perennial, aquatic herb with large, rounded leaves and large attractive, pink, red, or white flowers 15 to 25 cm in diameter. The flower has about 20 pink petals, 7 to 15 cm long. In the center of the flower is a large inverted conelike structure containing the ovaries which later become the seed.

The unripe seeds are eaten raw, boiled, or roasted, while the ripe ones are boiled or roasted.

Durian.—This is the seed of the durian fruit described in another group in this paper. The seed has no commercial value. The analysis reported was made on the boiled seeds.

Galo.—This tree is distributed in forests at low and medium altitudes from northern Luzon to Mindanao, and reaches to a height of 15 m or more and a diameter of 50 cm. The leaves are alternate and somewhat pointed at both ends. Galo nut is produced in the axils of the leaves with a thin shell about 2 cm in diameter. It has an edible kernel of good quality and taste.

Marang.—This fruit is described elsewhere in this report. The analysis reported here is made on the boiled seeds. The seeds, like those of the jackfruit, are large and starchy and are eaten either boiled or roasted.

MUNG BEAN (*Munggo*).—The bean samples were grown by the Bureau of Plant Industry and values presented are averages of 9 determinations on 9 varieties of the bean.

COWPEAS (*Paayap*).—These are the mature seeds of the cowpea legume. The various samples analyzed are of different varieties and they differ not only in size but also in color. Except for the first sample, the cowpeas presented in this report were from the Bureau of Plant Industry.

WATERMELON SEEDS (*Pakuwán, butó*).—Watermelon seeds have a good commercial value in the Philippines. The proximate composition of the white edible portion of the seed is comparable to that of peanut. A previous analysis has been reported in our first paper.

LEAFY VEGETABLES

Alibangbang.—This is a small sized but stocky tree growing to a height of 8 to 10 m in regions subject to long dry seasons. It has yellowish brown checked bark and a dense crown of branches. The leaves, which are broader than long, are 5 to 10 cm long, heart-shaped at the base and deeply notched at the apex. Alibangbang leaves, because of their sour taste, are used considerably for flavoring meat and fish as in "sinigang." Samples studied were obtained in San Rafael, Bulacan.

Asistasya.—This herb is found in thickets near towns at low altitude, and is being cultivated in Isabela, Manila, and Los Baños. The tender leaves of this trailing herb are eaten as pot-herb. Its leaves which are ovate, pointed at the tip and rounded at the base, measure 2½ to 3 cm in width. The sample reported in this paper was gathered from a Pasay side-street. Another sample has been reported in the second paper of this series.

Dampalit.—Another sample of this prostrate plant has been previously reported in the second paper.

PRICKLY-CHAFF FLOWERS (*Hanggod*).—This plant is a coarse, (or) rambling, erect, branching, hairy, annual herb from ½ to 2 m in height. The leaves are opposite, ovate, pointed at the base and tip, with short petioles, and 6 to 15 cm long. It is a weed which is distributed throughout the Philippines in open, waste places at low and medium altitudes.

Kamokamotihan—This is a hairy herbaceous vine, widely distributed and found growing at low and medium altitudes in waste places and thickets. Its young leaves and tender stems are in popular use in the Ilocano regions, particularly in Pangasinan, as a leafy vegetable. The leaves are somewhat heart-shaped, 5 to 15 cm long. Its stems are often purplish, 2 to 4 angled and narrowly winged. The sample reported in this paper was gathered from a Singalong (Manila) backyard. An analysis was included in the first paper.

SWAMP CABBAGE (*Kangkong*).—This smooth, widely spreading vine is another leafy vegetable which has been reported in the second paper.

CASHEW (*Kasuy*).—This tree is found cultivated throughout the Philippines for its fruit. The young leaves are also eaten as a vegetable. This is a very small tree with a usually small and crooked trunk. The leaves are simple, smooth, alternate, ovate, 10 to 20 cm long and 7½ cm wide with a slightly rounded emarginate apex. The sample of "kasuy" tops reported in this paper came from Ilocos Sur. The analysis of the fruit was included in the second paper.

Kutsarita.—The tops of this perennial herb of the green variety has been reported in our first paper. The present samples consisted of tender cuttings of the red variety from the gardens in Balara Filters (Quezon City).

BLACK NIGHT SHADE (*Lubi-lubi*).—This plant is about one meter or less in height. The stems are green and somewhat 3-angled. The leaves sampled came from Albay, Albay. The leaves are arranged in clusters, oblong, 10 to 30 cm long with lobed margins. It is popularly used as a vegetable especially in the Bicol Region.

MANGO (*Mangga*).—Analyses of mango fruit are included in the previous papers. The present sample consisted of shoots and tender stems which are used for flavoring meat and fish in some localities.

Sarsalida.—This plant is a slender, spreading herb with small, whorled and spatulate leaves and white flowers with long, slender petioles. The whole plant without the roots is eaten as a vegetable. It is bitter but taste for it can be developed. This plant is called "papait" in Ilocano.

PARSLEY (*Peregil*).—This erect, copiously branched herb is grown to some extent in Baguio. It reaches a height of about 90 cm. From its thick aromatic taproot radical rosette leaves 2 to 3 pinnate arise, ultimate segments being ovate-cuneate. Its curly leaves are used as a seasoning and for garnishing various dishes.

TAMARIND (*Sampalok*).—The first two papers of this series include the analyses of the green and ripe fruits of this large tree. The present sample consisted of young leaves which, like the green fruit are used for seasoning a native dish called "sinigang."

SPANISH PLUM (*Siniguwelas*).—The fruit has been reported elsewhere in this paper. The present sample consisted of shoots and tender stems which are used for seasoning "sinigang."

Tukod-lañgit.—This fern grows wild in moist places like banks of streams, though it is also found around bamboo thickets. The plant has an slender stem and leafy blades which spread out resembling an umbrella around a spike of about the same length. The tender and brittle fronds make an excellent green vegetable which is eaten either raw or cooked as a salad or as a component of stew.

Watercress.—This green aquatic plant, with creeping, floating and much-branched stem, is abundant in shallow waters and small streams in Trinidad Valley, Benguet. Watercress is used as a salad on account of its appetizing property. The sample which was obtained in Baguio, had erect and pinnate leaves, which measured 1½ to 2 cm long and 1½ to 2½ cm wide.

SEAWEEDS

Balbalulang.—This seaweed is netlike in appearance, has a spongy texture and is brown in color. It grows under the sea on rocks. It is never cooked or blanched, for it soften and disintegrates with heat. The sample came from Ilocos Norte.

Kulot.—It grows under the sea on rocks 5 to 7 meters deep. The fronds are not cartilaginous. The branchlets are very small and spinelike. It is blanched before eaten. The sample also came from Ilocos Norte.

Pukpuklo.—This seawed is most commonly found along the coast of Ilocos Norte and La Union, growing on rocky and sandy places. The thallus is described as being "more or less regularly dichotomous and cylindrical." It is eaten raw as a salad mixed with other vegetables.

FLOWERS

HIBISCUS (*Gumamela*).—This plant is an erect, much branched, smooth shrub 1 to 4 m in height, and is cultivated for ornamental purposes throughout the Philippines. The leaves are ovate and 7 to 12 cm long with coarsely toothed margins. The flowers which are solitary, axillary, very large, about 10 cm long and 12 cm in diameter are reported to be used for food. Its green calyx is about 2 cm long and with ovate lobe. The petals are red, obovate, rounded, and imbricate.

Kakawati.—This tree is used for ornamental purposes, because of its pink to light violet flowers. The wood is hard and durable so that the tree is used to make a living fence. The flowers are edible and used as vegetable.

TAMARIND (*Sampalok*).—The flowers of this large tree are also used for seasoning native dishes because its acid taste.

SHOOTS AND STEMS

Rhubarb.—This plant is grown to some extent around Baguio, thriving at higher elevations and in rich soil. It is raised in the rosette stage with large leaves. The pinkish fleshy leaf stalks are highly prized as filler for pies and for making sauces.

COCONUT BUD OR CABBAGE (*Ubod ng niyog*).—The innermost and tender upper position of the coconut trunk is known as "ubod." It is almost milky-white in color, rather crispy and juicy and has a sweetish taste. "Ubod" is considered a delicacy. It makes an excellent salad, is used in native pickles, and may be served plain boiled, but is most popularly used in preparing "lumpia."

FRUITS

GUAVAS (*Bayabas*).—This fruit is available throughout the year. Its analysis has been reported in the second paper of this series. In this report, both the red and white variety were analyzed.

Bignay.—This is the fruit of a small tree. It is not widely cultivated nor is the fruit very popular among Filipinos. However, bignay makes an excellent wine and jam. The fruit is small, hardly 1 cm long, fleshy, ovoid, smooth, dark red in color and slightly acidic even when ripe. It contains a single seed. The fruits analyzed were harvested from a private garden in Mandaluyong, Rizal.

Datilis.—This berry, which is popular among children, is rounded, small, about 1 cm in diameter, red, sweet; the cream-colored flesh contains numerous small seeds. The tree is small with spreading branches. The fruits sampled here were gathered from the Philippine General Hospital compound.

JAVA PLUM (*Duhat*).—This is a very popular seasonal fruit in the Philippines. It is oval in shape, varying from 1½ to 3½ cm long, with thin, dark purple or blackish violet skin, and a juicy, acid, purplish flesh enveloping a single large seed. The juice makes a delicious fruit drink and an excellent wine.

Durian.—The durian is a large tree which grows up to 20 m or more in height and is found in Mindanao and the Sulu Archipelago. The fruit is large, globose and pendulous, weighing around 1 to 3 kg. The skin is hard with coarse pyramidal spines, and internally, it is 4 to 5-celled with each division containing 2 to 6 seeds covered by a whitish soft aromatic flesh of the consistency of butter and with a very strong repugnant odor. The people of the regions where it grows prize the fruit highly, but many of those who come to know this fruit for the first time, find its odor very objectionable.

STAR APPLE (*Kaimito.*)—Analysis of this fruit has been reported in the second paper of this series. In this report, the purple variety was used.

GUAMACHIL (*Kamatsili*).—A previous analysis of this fruit has been reported in the second paper of this series. It was found to be outstanding in some of the food nutrients; hence another sampling was made for verification of previous analyses.

CASHEW FRUIT (*Kasuy*).—Due to the high ascorbic acid content of the fruit as reported in our second paper, we deemed it necessary to make another sampling of kasuy purchased from Antipolo, Rizal.

JABOTICABA (*Lipoti*).—These are small fruits, 1.5 to 2 cm in diameter or about the size of marble, dark thin-skinned and glossy with purplish white pulp and one-seeded. The fruits grow on short stalks from the thin smooth bark of the stem and branches. The fruits came from Quezon.

MANGO (*Mangga*).—This is one of the popular fruits in the Philippines. Due to nutrient variation that may result from soil, species or environment, we analyzed again 2 varieties of mangoes in different stages of maturity.

Marang.—This fruit is from a large tree which grows to about 12 to 25 m and a diameter of around 40 cm. The leaves are very rough, large, entire or lobed. Marang is fairly common in Mindanao and Mindoro. The fruit is about 15 cm long and 12 cm across, and is covered by very numerous slender projections. The seeds are enveloped with white, sweetish, juicy, very rich, and aromatic flesh, and are arranged radially around an oval pulpy mass. This has a finer and more delicate flavor than the jack fruit.

Santol.—The fruits sampled were submitted by the Bureau of Plant Industry. They were unusually large weighing an average of 225 grams with only 3 to 4 seeds per fruit, very little juice and a thick pericarp.

ZAPOTE (*Sapote*)—This rarely cultivated tall tree was introduced from Mexico. Sapote is found in Isabela, Nueva Ecija, Bataan, Rizal, Laguna, and probably in other provinces also. Its edible fruit is large globose, smooth, green, more or less depressed at its apex with its base enveloped by its calyx. The fruit is around 10 cm in diameter, and its yellowish flesh turns almost blackish at maturity.

SPANISH PLUM (*Siniguwelas*).—This fruit has previously been reported in the first paper. The present sample was obtained in Antipolo, Rizal.

PONDEROSA (*Tsiko-mamey*).—This fruit was included in the second paper. The present sample was obtained in Paete, Laguna.

Barbados gooseberry.—This is a climbing or trailing shrub of the cactus family with spiny stems, smooth glossy thick leaves, white flowers in clusters, and juicy, globular fruits, which are rarely 2 cm in diameter and are remarkable because they bear leaves. These, however, drop off as the fruit ripens to a yellow color. This acid fruit must be cooked with sugar to be palatable.

EGGS

ANT'S EGG (*Itlog ng langam*).—The eggs sampled are those of the red species. They are a little bit larger than rice grains and are of the same shape and color. Ant's eggs are considered a delicacy in the Ilocos Region. The eggs analyzed had been cooked with vinegar and salt.

HEN'S EGG (*Itlog ng manok*).—Eggs of three breeds of hens are included in this paper: Batangas, Rhode Island, and White Leghorn. Raw and hard-boiled eggs, as well as the egg yolks, and whites of each breed were analyzed.

TURTLE'S EGGS (*Itlog ng pagong*).—The eggs were shipped from Sulu. They were the size of ping-pong balls and were soft shelled. The whole of the egg is watery compared to hen's eggs and does readily coagulate. The cooked egg has a gritty and peculiar taste.

DUCK'S EGGS (*Itlog ng pato*).—Analyses of the whole raw egg, yolk and white are reported in this paper. Also included are the analyses of both the salted and the hard-boiled infertile duck's (*penoy*) eggs. The first paper of this series gives the report of the work on incubated duck's egg (*balut*).

RESULTS AND DISCUSSION

The result of the analyses of 124 samples consisting of 103 plant foods and 21 animal foods are presented in this paper. The values for the following constituents are reported: moisture, nitrogen, fat, ash, calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin and ascorbic acid. The values are given for the amounts of the respective nutrients in terms of 100 gm of the edible portion.

Cereals.—The nutrient values of 10 samples of rice do not vary considerably. Moisture ranges from 10 to 15 per cent; there is little variation in nitrogen content; the ether extract, crude fiber, ash, thiamine, riboflavin and niacin are higher in the unpolished and colored varieties of rice ("pirirutong" and red variety of rice); calcium of white rice averages 8 mg per cent while phosphorus ranges from 80 to 200 mg per cent. On the whole this cereal is a significant source of protein and niacin. Enriched rice as expected is most outstanding in iron, thiamine and niacin. Rice polishings are exceptionally high in phosphorus and the B complex vitamins. Many of the rice products due to processing methods become mainly a source for carbohydrate.

The trend in nutrient value for corn is very much similar to other cereals except for the presence of carotene in yellow corn. The carotene value reported in this paper represents only those of beta carotene. Cryptoxanthine, which is present at a higher percentage than beta carotene, contributes in a large measure to the vitamin A value of corn. Significantly high values were also obtained for thiamine (approximately 0.3 mg).

Starches and starchy roots.—Most of the local starches are reported in the second paper of this series. The results obtained from 4 samples show that the main food constituent is starch and other nutrients in low values.

Sugars and syrups.—Noteworthy among the samples analyzed in this food group is the higher mineral content of crude sugar which gradually lowers as a higher degree of refining is attained.

Pulses, nuts and seeds.—The foods in this group, sometimes known as "meat extenders" are so aptly termed due to the high content of nitrogen which is comparable in amount to that present in meat (2.228 to 7.118 gm nitrogen in dried beans). Among the samples of beans and cowpeas analyzed, the thiamine content average approximately 0.6 mg per cent and 0.3 mg per cent for riboflavin. Calcium ranges from 36 to 300 mg while the iron content varies from 1 mg to 12 mg. As a whole, among the beans analyzed in this report, soybean is the highest in nutrient value followed by mung bean and the cowpeas.

Vegetables.—Many of the leafy vegetables reported were not as popularly used as those reported in the previous papers. Some of them are regional in occurrence and in use. In general, the importance of these vegetables would depend very much upon the way in which they are used in the diet. Some of these vegetables are used for flavoring only while others are used as a major part of the main dish. "Peregil" and watercress are widely used for garnishing some dishes while young leaves of alibangbang, mongo, siniguwelas, and kasuy are used for flavoring meat and fish.

The calcium content varies from 10 to 300 mg in round figures. The availability of this mineral from their respective leaves is not however, determined. "Papait" and "dampalit" contain significant amounts of iron (8.89 and 16.88 mg respectively). "Asistasya" and "hangod" are among the highest in carotene content giving 6.8211 mg and 6.5535 mg respectively. This is followed by "kangkong" having a value of 4.2166 mg. "Kamokamotihan," "asistasya," parsley and "hangod" are good sources of thiamine (0.219, 0.218, 0.165, and 0.133 mg respectively). Except for kasuy leaves, the leafy vegetables presented in this paper contain significant amount of riboflavin. High values for ascorbic acid were found in parsley (153.4 mg.), cashew leaves (89.01 mg), "asistasya" (56.9 mg), and "kamokamotihan" (53.8 mg).

The three (3) samples of seaweeds have been found to be high in mineral content especially "balbalulang" and "kulot" which contain 649 and 351 mg calcium respectively and 44.5 and 75 mg iron.

No outstanding nutrient values were found in the flowers, shoot and stem analyzed.

Fruits.—Many of the fruits included in this report are either seasonal or regional. A few contain fairly high amounts of nitrogen: "kamatsili" (0.506 gm), "datilis" (0.329 gm), and "tsiko mamey" (0.322 gm). Of comparable fat content of avocado (7.23 gm as reported in second paper) is "sapote" which contains 7.47 gm. A wide range in the calcium values varying from 5 to 174 mg may be noted. In the case of iron, values were mostly under 1 mg except "marang" (3.48 mg), "durian" (1.3 mg), "tsiko mamey" (1.85 mg), and siniguwelas (1.14 mg). "Tsiko mamey" and mango contain significant amounts of carotene (1.9296 mg and 1.3022 mg respectively). Exceptionally high values for thiamine were found in "durian" (0.366 mg), "kamatsili" (0.139 mg), ripe mango (0.107 mg), and "siniguwelas" (0.103 mg). Except for "durian" with a riboflavin content of 0.172 mg the other fruits in this series contain relatively low amounts of riboflavin. Good amounts of niacin were noted in "tsiko mamey" (2.80 mg), mango (1.24 mg), and "durian" (1.13 mg). A wide variation in ascorbic acid values was noted with "kasuy," "datilis," "kamatsili," and guavas containing 159, 152, 122, and 113 mg respectively.

Eggs.—The four varieties of eggs in this report do not vary considerably in nutrient values except for the following: ant's eggs have a nitrogen content comparable to hen's yolk and is highest in iron (19.15 mg) and thiamine (0.433 mg) and high in riboflavin (0.744 mg). On the other hand, duck's egg is considerably higher in both carotene and thiamine than the others, although very low in iron.

SUMMARY

Results from analyses of 124 samples consisting of 103 plant foods and 21 animal foods are presented. These samples included 30 cereals, 4 starches, 7 sugars and syrups, 16 pulses, nuts and seeds, 16 leafy vegetables, 3 seaweeds, 3 flowers, 2 shoots, 22 fruits, and 21 eggs from fowls, reptile and insects. The tables presented include scientific and local names of each sample and values for edible portion, moisture, nitrogen, fat, crude fiber, ash, calcium, phosphorus, iron, carotene, thiamine, riboflavin, and niacin.

Different food groups contribute specific nutrients. Cereals, starches and the sugars, for example, contain large percentage of carbohydrate. Some samples under these groups have a relatively high value for one or more constituents other than

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion												
					Moisture	Nitrogen	Fat	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
	BIGAS		RICE AND RICE PRODUCTS	*Per cent*	*gm*	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
1	Bigas, hilaw, Kinarlos.	*Oryza sativa* L.	“Kinarlos” rice, raw	------	10.6	1.581	0.67	0.84	0.58	9.28	148.37	1.70	------	0.150	0.075	4.39	------
2	Bigas, hilaw, Kiniskis.	do.	Polished rice, raw	------	14.0	1.131	0.60	0.86	0.36	7.03	103.12	0.46	------	0.081	0.044	2.22	------
3	Bigas, hilaw, malagkit.	*Oryza glutinosa* Lour.	Glutinous rice, raw	------	12.9	1.095	0.96	0.54	0.17	8.11	91.42	0.49	------	0.146	0.061	2.40	------
4	Bigas, hilaw, milagrosa.	*Oryza sativa* L.	“Milagrosa” rice raw,	------	11.0	1.005	0.62	0.52	0.19	7.16	85.96	0.32	------	0.143	0.073	2.27	------
5	Bigas, hilaw, pinawa.	do.	Unpolished rice, raw	------	11.0	1.396	2.88	1.44	0.88	8.83	195.19	1.11	------	0.426	0.063	5.58	------
6	Bigas, hilaw, pirurutong.	------	Dark colored rice, raw	------	10.5	1.607	2.62	1.57	0.79	20.60	301.50	3.50	------	0.476	0.221	6.75	------
7	Bigas, hilaw, pula.	do.	Red variety rice, raw	------	13.3	1.267	0.94	1.06	0.50	16.07	163.47	0.25	------	0.210	0.119	3.94	------
8	Bigas, hilaw, Ramilad.	do.	“Ramilad” rice, raw	------	------	0.821	0.73	0.57	0.24	10.45	203.75	1.13	------	0.109	0.023	2.30	------
9	Bigas, hilaw, wagwag.	do.	“Wagwag” rice, raw	------	10.7	1.197	0.34	0.69	0.20	6.53	116.93	1.01	------	0.116	0.078	3.21	------
10	Bigas, hilaw, may bitamina.	do.	Enriched rice raw	------	14.0	1.131	0.60	0.86	0.36	7.03	103.12	3.20	------	0.480	0.044	5.87	------
11	Bigas, luto, may bitamina.	do.	Enriched rice, cooked	------	61.0	0.452	0.05	0.16	------	5.60	------	1.22	------	0.153	0.060	1.44	------
12	Bigas, luto, Ramilad.	do.	Ramilad rice, cooked	------	52.2	0.266	------	------	0.09	------	21.83	0.59	------	0.016	0.013	------	------
13	Bihon	------	Noodles	------	12.9	0.785	0.08	0.24	0.17	6.47	34.64	1.88	------	0.004	0.006	0.11	------
14	Bihon, luto	------	Noodles, cooked	------	76.4	0.221	------	0.06	------	3.95	9.71	0.60	------	0.001	0.002	0.04	------
15	Darak	------	Rice polishings	------	11.5	1.639	12.24	8.69	4.85	64.50	972.26	15.10	------	1.925	0.266	28.07	------
16	Do.	------	do.	------	7.7	1.713	18.50	10.00	7.38	77.74	1,474.45	10.03	------	1.782	0.253	37.07	------
17	Do.	------	do.	------	------	------	------	10.30	------	59.99	859.24	16.21	------	1.213	0.267	23.29	------
18	Pideos	------	Vermicelli	------	11.3	1.696	0.15	0.57	0.14	16.33	70.90	0.67	------	0.237	0.096	2.10	------
19	Sutanghon	------	Noodle	------	14.1	0.047	0.10	0.12	------	17.27	10.95	1.07	------	0.007	0.006	0.11	------
20	Sutanghon, luto.	------	Noodle, cooked.	------	82.9	0.011	------	0.03	------	9.70	2.40	0.68	------	0.001	0.000	0.03	------

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion												
					Moisture	Nitrogen	Fat	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm*	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
	WHEAT AND WHEAT PRODUCTS																
21	Macaroni	------	Macaroni	------	13.3	1.931	0.49	0.46	0.09	22.20	81.43	1.93	------	0.405	0.228	4.00	------
22	Mique	------	Noodle	------	8.5	1.988	22.41	1.49	------	46.15	69.80	2.85	------	0.173	0.031	2.29	------
23	Mique, luto	------	Noodle, cooked.	------	74.3	0.552	------	0.39	------	8.90	19.40	0.57	------	0.017	0.019	0.63	------
24	Misua	------	Noodle, raw	------	11.9	2.179	0.09	4.06	------	47.70	76.30	2.05	------	0.290	0.040	3.45	------
25	Misua, luto	------	Noodle, cooked.	------	84.5	0.476	------	0.71	------	9.90	13.70	0.40	------	0.052	0.016	0.90	------
	MAIS		CORN AND CORN PRODUCTS														
1	Mais, dilaw	*Zea mays* L.	Yellow corn	------	53.0	0.788	1.93	0.89	0.95	3.90	116.30	0.70	0.260*	0.257	0.150	1.46	10.3
2	Mais, dilaw, luto.	do.	Yellow corn, cooked.	------	57.6	0.728	------	0.70	------	12.70	150.40	1.44	0.159*	0.128	0.095	0.93	6.0
3	Mais, dilaw, giniling.	do.	Yellow, corn meal.	------	5.8	1.320	3.66	1.32	0.77	10.82	201.32	0.78	0.142*	0.316	0.097	1.75	------
4	Mais, puti	do.	White corn	33.8	64.1	0.729	0.85	0.89	2.42	7.91	136.88	0.66	------	0.296	0.105	1.72	7.8
5	Mais, puti, luto.	do.	White corn, cooked.	38.4	64.3	0.728	3.54	0.87	2.48	7.12	126.75	0.71	------	0.184	0.081	1.34	5.6
6	Mais, puti, giniling.	do.	White corn, meal.	------	5.5	1.249	3.58	1.59	1.48	13.25	151.42	1.51	------	0.291	0.097	1.60	------

* Value is for B—carotene only.

	STARCHES																
1	Kamoteng kahoy, arina	*Manihot utilisima* Pohl.	Cassava flour	100	11.4	0.377	0.52	1.99	1.49	52.26	63.26	0.45	------	0.027	0.024	1.11	------
2	Do	do	do	100	8.1	0.076	0.59	0.72	2.82	78.52	23.34	1.02	------	0.022	0.036	0.31	------
3	Do	do	do	100	7.7	0.080	0.45	0.66	2.18	121.29	25.67	1.66	------	0.023	0.030	0.32	------
4	Kamoteng	do	Cassava grits	100	9.2	0.284	0.89	0.72	2.73	45.82	25.42	0.41	------	0.012	0.025	0.36	------
	SUGARS AND SYRUPS																
1	Asukal, ikalawang klase	*Saccharum officinarum* L.	Sugar, 2nd class	100	0.02	------	------	0.02	------	2.90	------	0.15	------	------	------	------	------
2	Asukal, ikatlong klase	do	Sugar, 3rd class	100	0.08	------	------	0.06	------	6.59	2.12	0.14	------	------	------	------	------
3	Asukal, ika apat na klase	do	Sugar, 4th class	100	0.80	------	------	0.28	------	24.28	3.84	0.53	------	------	------	------	------
4	Matamis na bao	do	"Cocohoney"	100	8.4	0.870	39.47	1.55	------	26.80	143.90	4.24	------	0.003	0.135	1.00	------
5	Pakaskas	do	------	100	6.9	0.244	0.35	3.04	------	------	88.61	3.03	------	0.012	0.105	------	------
6	Panotsa	do	Crude sugar	100	5.5	0.034	0.16	0.62	------	28.70	52.10	2.72	------	0.015	0.028	0.27	------
7	Tubo, katas	do	Sugar cane juice	------	86.2	0.019	0.16	0.48	2.60	8.40	10.60	0	------	0.006	0.006	0.06	------
	PULSES, NUTS AND SEEDS																
1	Abitsuwelas, pula	*Phaseolus vulgaris* L.	Red kidney beans	100	2.4	2.228	1.78	3.72	4.02	38.60	361.57	9.63	tr.	0.309	0.263	1.55	------
2	Do	do	Bountiful beans	100	11.2	2.655	1.49	3.74	------	75.16	384.12	9.35	tr.	0.309	0.309	2.20	------
3	Balatong	*Glycine Max* (L.)	Soybean	100	6.1	7.118	16.74	5.19	4.88	312.13	555.80	12.81	------	0.426	0.168	2.16	tr.
4	Baino	*Nolumbinum nelumbo* (L) Druce	------	49.2	80.4	0.660	1.14	0.94	0.60	62.25	121.96	0.90	------	0.223	0.034	2.31	14.48

Item	Local name	Scientific name	English name	Edible Portion	Representative values for 100 gm edible portion												
					Moisture	Nitrogen	Fat	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic Acid
				Per cent	*gm*	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
5	Durian, buto (luto)	*Durio zibethinus* Murr	Durian seed, cooked	73.0	51.1	0.297	0.23	1.00	0.71	33.30	86.65	0.64	------	0.032	0.052	0.89	------
6	Galo, bunga bunga.	*Anacolosa luzoriensis* Merr.	------	28.6	74.3	0.615	0.35	0.79	0.76	26.98	50.26	1.27	0.7264	0.066	0.081	1.08	19.84
7	Galo, buto (luto).	do.	------	26.7	44.9	0.670	2.55	1.02	1.76	23.33	127.39	0.98	------	0.144	0.137	0.93	9.32
8	Galo, bunga at buto.	do.	------	87.3	59.6	0.624	1.85	1.29	1.90	24.67	65.36	1.75	0.4076	0.103	0.098	1.89	21.26
9	Marang, buto (luto).	*Artocarpus odoratissima* Blanco	Marang seed	------	48.5	0.497	6.12	0.63	0.67	26.70	116.66	0.59	------	0.259	0.045	0.65	------
10	Munggo	*Phaseolus aureus* Roxb.	Mung bean	100	4.2	3.946	1.02	4.02	4.45	128.73	346.26	5.64	0.0813	0.640	0.189	3.00	9.55
11	Paayap	*Vigna sinensis* L.	Cowpeas	100	14.0	3.490	1.31	3.27	2.79	100.64	420.43	8.71	0.0046	0.466	0.269	2.00	------
12	Paayap, kibal.	do.	do.	100	2.7	3.634	1.52	3.19	5.11	86.18	288.13	5.88	tr.	0.518	0.326	2.67	------
13	Paayap "blackeye".	do.	Black eye cowpeas	100	3.9	3.460	2.14	3.12	3.23	39.31	335.59	7.06	tr.	0.700	0.316	1.78	------
14	Paayap "new era".	do.	New Era Cowpeas	100	3.0	3.087	1.83	3.51	5.51	36.39	355.40	4.71	tr.	0.982	0.373	1.71	------
15	Paayap, itim	do.	Black cowpeas	100	2.3	3.345	1.78	3.78	3.22	44.01	270.07	1.30	0.0088	0.538	0.145	2.92	------
16	Pakuwán, buto	*Citryllus vulgaris* Schrad.	Watermelon seeds	35.9	7.3	5.915	49.62	2.83	2.48	60.13	305.96	7.77	------	0.017	0.057	0.92	------
	A. LEAFY VEGETABLES																
1	Alibangbang	*Bauhinia malabarica* Roxb.	------	80.0	86.9	0.541	1.03	0.44	1.77	46.42	31.10	0.32	0.8670	0.023	0.171	1.44	10.19
2	Asistasya	*Asystasia gangetica* (L.) T. Andres	------	------	78.1	0.536	0.90	2.31	0.80	216.46	26.55	1.26	6.8211	0.218	0.244	1.00	56.88
3	Dampalit	*Sesuvium potulacastrum* L.	------	33.2	85.9	0.410	0.41	5.40	0.71	61.82	23.80	16.88	2.6587	0.032	0.193	0.68	28.75
4	Hanggod	*Achyranthes aspera* L.	Prickly chaff flower	72.2	85.0	1.020	0.97	1.36	0.77	157.84	58.76	tr.	6.5535	0.133	0.475	1.02	30.31

5	Kamokamotihan.	*Operculina turpethum* (L) S. Manso.	Turpeth root	------	85.3	0.606	1.04	1.29	0.91	99.93	90.47	1.43	3.4234	0.219	0.225	1.11	53.76
6	Kangkong	*Ipomoea reptans* (L) Poir.	Swamp cabbage.	------	90.9	0.458	0.78	1.63	0.72	51.47	43.85	0.57	4.2166	0.091	0.235	0.93	34.79
7	Kasuy	*Anacardium occidentale* L.	Cashew	------	69.9	0.834	0.65	1.17	------	------	------	------	0.6156	0.007	0.009	1.35	89.07
8	Kutsarita, pula.	*Alternanthera versicolor* L.	------	------	60.4	0.362	0.63	2.30	1.05	231.18	31.10	1.36	2.3823	0.007	0.133	1.04	13.54
9	Lubi-lubi	*Solanum nigrum* L.	Black nightshade.	59.0	85.0	0.713	0.31	1.64	1.08	222.13	94.30	2.26	2.1598	0.095	0.244	1.31	20.47
10	Mangga, talbos.	*Mangifera indica* L.	Mango tops	89.1	83.8	0.413	0.40	2.50	1.63	8.45	54.99	4.06	------	0.059	0.076	1.52	26.32
11	Papait	*Mallugo oppositifolia* L.	------	------	86.4	0.880	0.84	2.15	1.40	136.56	37.82	8.89	3.1562	0.038	0.265	0.78	31.00
12	Peregil	*Petroselinum hortense* Hoffm.	Parsley	62.8	83.7	0.775	0.73	1.99	0.84	254.75	43.97	1.76	0.7339	0.165	0.263	0.68	153.44
13	Sampalok, talbos.;	*Tamarindus indica* L.	Tamarind tops	77.3	80.1	0.774	0.97	0.75	1.27	32.6	73.1	1.45	1.3330	0.172	0.190	1.53	5.80
14	Siniguwelas	*Spondias purpurea* L.	Spanish plum tops	76.3	88.6	0.685	0.84	1.15	1.61	11.75	73.44	2.77	------	0.078	0.121	1.54	23.41
15	Tukod-langit	*Helmintostachys zeylanica* (L).	------	------	82.9	0.475	0.60	0.94	0.98	47.95	91.50	1.79	2.1052	0.000	0.097	0.89	45.90
16	------	*Nasturtium aquaticum* L.	Watercress	45.3	95.9	0.181	0.32	0.63	0.21	292.49	27.39	0.58	0.4774	0.058	0.070	0.94	20.25
	B. SEAWEED																
1	Balbalulang	------	------	100.0	88.3	0.057	0.26	6.35	0.68	648.75	21.71	44.54	------	0.003	0.026	0.23	------
2	Kulot	*Laurencia esticulosa* (Forsk) Grev.	------	100.0	90.0	0.123	0.59	3.05	0.67	351.41	10.26	71.59	tr.	0.002	0.023	0.09	tr.
3	Pukpuklo	*Kodium Tenue* Kuetz.	------	------	92.9	0.200	0.15	3.91	0.12	62.30	8.15	2.08	0.1716	0.010	0.002	0.06	tr.

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion													
					Moisture	Nitrogen	Fat	Fat Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiaflavin	Riboflavin	Niacin	Ascorbic
				Per cent	*gm*	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
	C. FLOWERS																
1	Gumamela	*Hibiscus rosa-sinenses* L.	Hibiscus	61.6	89.8	0.064	0.36	0.55	1.56	4.04	26.68	1.69	--------	0.031	0.048	0.61	4.16
2	Kakawati	*Gliricidia sepium* (Jacq.) Steud.		85.0	84.7	0.391	0.58	0.48	1.38	17.11	33.68	0.83	--------	0.136	0.082	0.99	11.78
3	Sampaloc	*Tamarindus indica* L.	Tamarind	78.1	80.1	0.349	2.16	0.74	0.82	70.50	42.26	1.17	0.0970	0.089	0.086	1.18	9.22
	D. SHOOT AND STEM																
1	Rhubarb	*Rheum rhaporticum* L.	Rhubarb	72.9	94.5	0.070	0.38	0.72	0.77	79.40	10.03	0.54	0.0450	0.022	0.028	0.20	20.63
2	Ubod	*Cocos nucifera* L.	Coconut shoot.	33.9	89.6	0.329	0.68	1.31	0.75	27.26	51.63	tr.	--------	0.034	0.037	1.19	10.56
	FRUITS																
1	Bayabas, pula	*Psidium guajava* L.	Guavas, red	98.0	53.8	0.203	0.33	0.90	6.87	48.80	31.08	0.52	0.0816	0.077	0.048	2.19	83.13
2	Bayabas, puti	*Psidium guajava* L.	Guavas, white	97.4	57.8	0.263	0.36	0.89	6.58	26.19	31.99	0.60	0.0430	0.079	0.048	2.37	112.50
3	Bignay	*Antidesma bunius* L. Spreng.		13.2	89.4	0.103	0.80	0.72	1.45	33.64	22.24	0.48	0.0059	0.011	0.081	0.23	9.92
4	Datilis	*Muntingia calabura* L.		100.0	74.2	0.329	0.60	0.88	2.36	109.45	40.20	0.64	tr.	0.034	0.061	0.44	152.19
5	Duhat	*Syzygium cumini* (L) Skeels.	Java plum, Black plum	63.7	78.4	0.163	0.13	1.09	0.29	34.26	23.42	0.22	tr.	0.002	0.009	0.20	10.15
6	Durian	*Durio zibethinus* Murr.	Durian	14.5	54.9	0.211	0.71	0.91	1.87	12.14	65.39	1.13	--------	0.366	0.172	1.13	50.00
7	Kaimito, murado.	*Chrysophyllum caimito* L.	Star apple	62.8	80.5	0.213	0.65	0.25	0.03	14.30	8.80	0.24	tr.	0.011	0.011	0.88	5.50
8	Kamatsili	*Pithecolobium dulce* (Roxb.) Benth.	Guamachil	50.5	75.5	0.506	0.88	0.47	1.46	10.24	33.02	0.40	0.3650	0.139	0.088	0.76	122.10
9	Kasuy	*Anacardium occidentale* L.	Cashew	90.2	82.9	0.090	0.75	0.36	0.30	6.89	13.46	0.45	0.0090	0.025	0.018	0.38	159.36

10	Lipoti	*Eugenia polycephaloides* C. B. Rob.	Jaboticaba	78.4	80.0	0.105	2.87	0.43	1.30	82.61	20.50	tr.	--------	0.012	0.025	0.30	10.58
11	Mangga, kalabaw, hilaw	*Mangifera indica* L.	Mango, green	66.8	84.1	0.048	0.27	1.99	0.46	20.54	7.80	0.34	0.0408	0.074	0.023	0.19	72.25
12	Mangga, kalabaw manibalang.	do.	Mango, half-ripe.	67.4	82.1	0.072	0.24	0.36	0.29	7.62	9.90	0.86	0.1322	0.097	0.021	0.36	46.99
13	Mangga, kalabaw, hinog	do.	Mango, ripe	72.6	82.5	0.085	0.39	0.37	0.36	10.52	13.72	0.43	1.3022	0.107	0.046	0.57	28.44
14	Mangga, piko, hilaw.	do.	Mango, green.	70.5	85.0	0.052	0.80	0.28	0.39	11.21	10.43	0.35	0.0192	0.073	0.018	0.22	49.39
15	Mangga, piko, manibalang.	do.	Mango, half-ripe.	71.4	80.1	0.058	0.92	0.29	0.23	17.94	7.90	0.35	0.0909	0.050	0.020	0.27	51.04
16	Mangga, piko, hinog.	do.	Mango, ripe	66.2	79.0	0.065	0.62	0.31	0.46	12.38	11.42	0.25	0.8885	0.047	0.049	1.24	33.97
17	Marang	*Artocarpus odoratissima* Blanco.	--------	49.7	70.6	0.083	0.22	0.76	0.82	12.01	33.17	3.48	--------	0.065	0.050	0.57	29.64
18	Santol	*Sandoricum Koetjape* (Burm. f.) Merr.	--------	69.4	85.4	0.061	0.52	0.39	1.26	5.38	12.57	0.86	--------	0.037	0.016	0.78	14.89
19	Sapote	*Diospyros ebenaster* Ritz.	Zapote	83.5	77.8	0.108	7.47	0.68	0.18	14.98	24.95	0.32	0.0181	0.002	0.053	0.29	3.88
20	Siniguwelas	*Spondias purpurea* L.	Spanish plum	71.4	74.0	0.275	0.59	0.71	0.51	16.52	43.15	1.14	0.1506	0.103	0.031	0.48	28.59
21	Tsiko mamey	*Calocarpum sapota* (Jacq.) Merr.	Ponderosa	------	65.6	0.322	0.28	1.09	0.79	19.58	30.76	1.85	0.1250	0.009	0.022	2.80	7.87
22	-------------	*Pereskia aculatea.*	Brazilian berries.	46.4	91.4	0.162	0.73	0.64	0.70	173.83	26.00	tr.	1.9296	0.034	0.028	0.51	2.25

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm edible portion												
					Moisture	Nitrogen	Fat	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm*	*gm*	*gm*	*gm*	*gm*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
	ITLOG		EGGS														
	Manok (Buong itlog, hilaw):		Hen (Whole egg, raw):														
1	Batangas				71.0	2.009	13.27	1.06	-------	78.48	208.20	4.30	0.0700	0.084	0.571	0.11	-------
2	Rhode Island				72.6	2.079	12.57	0.86	-------	74.23	166.44	3.17	0.0496	0.076	0.330	0.07	-------
3	White Leghorn.				74.4	2.014	9.70	0.91	-------	74.97	166.19	3.14	0.0169	0.092	0.536	0.06	-------
	Buong Itlog, luto:		Whole egg, hard-boiled:														
1	Batangas				71.6	2.001	13.60	0.96	-------	73.70	172.78	4.11	0.0438	0.103	0.346	0.06	-------
2	Rhode Island				72.7	2.070	10.81	0.91	-------	66.87	166.50	3.24	0.0169	0.070	0.366	0.06	-------
3	White Leghorn.				72.0	2.206	12.96	0.96	-------	79.49	201.29	3.22	0.0088	0.113	0.403	0.05	-------
	PULA		YOLK														
1	Batangas				54.0	2.988	27.18	1.38	-------	144.43	270.45	6.30	0.0870	0.171	0.392	0.06	-------
2	Rhode Island				51.5	2.572	28.87	1.49	-------	153.25	345.40	6.96	0.0240	0.236	0.786	0.04	-------
3	White Leghorn.				53.2	2.729	17.94	1.48	-------	165.70	341.89	2.62	0.0257	0.209	0.581	0.03	-------
	PUTI		WHITE														
1	Batangas				79.7	1.960	0.30	0.58	-------	11.10	12.79	0.63	-------	0.005	0.164	0.07	-------
2	Rhode Island				86.2	1.773	0.16	0.16	-------	9.75	10.63	0.67	-------	0.011	0.325	0.14	-------
3	White Leghorn.				86.2	1.537	0.23	0.41	-------	8.66	10.81	0.51	-------	0.029	0.313	0.08	-------

1	Buo, hilaw	--------	Whole, raw	------	71.1	1.745	12.61	1.04	--------	72.00	175.97	0.76	1.2378	0.270	0.410	0.08	--------
2	Pula	--------	Yolk	------	48.7	2.454	29.68	1.54	--------	145.61	199.20	1.19	2.3219	0.540	0.941	0.24	--------
3	Puti	--------	White	------	86.3	1.678	0.07	0.64	--------	5.21	7.77	tr.	--------	0.006	0.019	0.15	--------
4	Penoy	--------	Hard-boiled infertile egg.	------	70.4	2.338	11.56	0.93	--------	61.65	165.94	1.18	0.6895	0.183	0.344	0.20	--------
5	Inasnan	--------	Salted duck's egg.	------	66.4	2.152	13.69	2.91	--------	99.46	153.54	1.96	1.0737	0.220	0.427	0.08	--------
	LANGAM		ANT'S EGGS	------	71.0	2.776	8.84	2.75	--------	52.00	217.02	19.15	--------	0.433	0.744	--------	--------
	PAGONG		TURTLE														
1	Buo	--------	Whole	90.6	80.6	1.922	10.15	1.19	--------	84.35	193.11	1.31	0.0177	0.113	0.459	0.01	--------
2	Pula	--------	Yolk	53.7	74.4	2.972	20.15	1.61	--------	141.12	246.68	2.24	0.0241	0.163	0.489	0.01	--------
3	Puti	--------	White	37.6	97.2	0.145	0.84	0.56	--------	14.55	7.28	tr.	--------	0.007	0.014	0.01	--------

carbohydrate. Most of the pulses, nuts and seeds contain high amounts of nitrogen, iron, and the B vitamins. Vegetable plants and fruits reported came from different regions of the Philippines. The data indicate that many of these foods which are known and used only in certain regions, are rich in various nutrients.

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THE ORDER XYRIDALES OF DR. HAYATA'S INDO-CHINESE COLLECTION

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SIX PLATES

A considerable number of Indo-Chinese materials which may be reckoned at several thousand sheets are preserved in the Herbarium of the (Imperial) University of Tokyo. The collection had been made by the late Professor B. Hayata during his botanical exploration to French Indo-China, in a series of travels over a period of six years. According to his notes, his first travel to Tonkin and Yünnan had been done from June to August in 1917; in next one extending from May to June in 1921, Dr. Hayata and Mr. Lagrange had left their footmarks in Annam; and from September to December in 1921, they had a third travel to north-western Siam. Concerning the Cyperaceæ of this collection, I have already reported. The present paper, a continuation of the above one, is an enumeration of the members of the Xyridaceæ and Eriocaulaceæ, in which I hope to publish eight new entities and two new records of distribution. The known number of the members of the Indo-Chinese *Eriocaulon* is a respectable increase to that of Professor Lecomte's day, but still it will be said that the number allows a margin for growth in number of species when we have another collection.

Some of the references consulted in preparing this paper have been supplied by Professor H. Hara of our institute and Dr. H. N. Moldenke, Director of the Trailside Museum, U.S.A. Mr. H. Keng of the National Taiwan University, China, sent me some fragments of type specimens preserved in his university. Without these materials, no comprehensive study of this highly technical order could have been possible. To all of them I express my heartfelt thanks.

XYRIDACEÆ

1. XYRIS ADUSTA T. Koyama, sp. nov. Plate 1, fig. 1 and Plate 6, fig. B.

Rhizomatosa. Folia erecta linearia subcoriacea rigidula plana torta 7–30 cm alta 2–3 mm lata lævia obsoletissime plurinervosa apice gradatim attenuata acuta basi longiuscule vaginantia,

vaginis usque ad 7 cm longis basi compressis fuscopurpureis margine anguste membranaceis, ligulis plerumque non evolutis sed raro oblongis hyalinis ad 1.2 mm longis. Pedunculi 35–60 cm alti graciles firmi laeves leviter compressi ita oblongi vel elliptici in sectione transversali. Spica unica terminalis pluriflora fusca ellipsoidea vel ovoidea 9–15 mm longa 7–10 mm in diametro. Bracteæ squamiformes spisse imbricatim dispositæ, inferiores 5–7 steriles divergentes minores obovato-orbiculatæ vel orbiculatæ interdum reniformiorbiculatæ 2.5–3 mm longæ coriaceæ medio castaneæ convexæ dorso fulvae et minute dense puncticulatæ latere fuscatæ margine integræ apice emarginatæ rotundatæve, religuæ floriferæ patentes late obovatæ vel obovato-orbiculatæ 5.5–7 mm longæ supra medium 5.5–6 mm latæ valde naviculares corriaceæ obsolete et tenuiter 5-nerviæ medio castaneæ vel brunneæ nitidulæ latere fuscæ margine cartillagineæ primo integræ maturitate irregulariter fissæ apice obtusissimæ plerumgue emarginatæ, parte dorsali dilute fulva dense puncticulata triangulata distincte definita. Sepala lateralia anguste oblanceolata 5.5–6 mm longa superne 1 mm lata fusco-brunnescentia margine hyalina integra demum irregulariter fissa, carina incurva a medio ad apicem latiuscule alata læviuscula interdum a medio versus apicem inconspicue serrulatoscabra. Capsula castanea opaca obovoidea 3 mm longa 2 mm crassa. Semina ellipsoidea ⅘ mm longa multicostata.

SIAM: Nakay (B. Hayata, December 16, 1921, sin. num.!—holotypus in TI *.

2. XYRIS CAPENSIS Thunberg var. SCHŒNOIDES (Mart.) Nilsson.

Xyris capensis THUNBERG var. *schœnoides* (Mart.) NILSSON in Ofvers. Vet. Akad. Förhandl. 3 (1891) 154–155; MALME in Lecomte, Flor. Génér. de l'Indo-Chine 6 (1934) 835; VAN ROYEN in Van Steenis, Fl. Malesiana ser. 1, 4, pt. 4 (1953) 374–5, ff. 1:0 et 6–8.

ANNAM: Dalat (B. Hayata, 595!)—India, Malaysia, China.

Note. A common *Xyris* of which the mother species widely extends in the tropic regions of the Old World from Africa to Australia. In our Annam plants, short soft hairs on peduncle are inconspicuous.

3. XYRIS COMPLANATA R. Brown.

Xyris complanata R. BROWN, Prodr. Fl. Nov. Holl. 1 (1810) 256; MALME, l. c. 839; VAN ROYEN, l. c. 369, f. 1: A.

ANNAM: Ya Thi (B. Hayata, sin. num.!)—India, China, Malaysia, Australia.

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* TI is used for the herbarium of the University of Tokyo.

Note. Considerably variable in length of leaves and height of stems, but fairly well recognized by a distinct rigid rib in both scabrous margins of strongly compressed blades.

4. XYRIS INDICA Linnæus.

Xyris indica LINNÆUS, Sp. Pl. ed. 1 (1753) 42, emend. J. E. SMITH in Rees, Cycloped. (1819) 30; MALME, l. c. 835; VAN ROYEN, l. c. 373, ff. 1: N et 4.—*X. capito* HANCE in Journ. Bot. 14 (1876) 262; MALME, l. c. 836.

SIAM: Nakay (B. Hayata, sin. num.!)—India, Indo-China, Malaysia, Australia.

5. XYRIS MARITIMA T. Koyama, sp. nov. Plate 1, fig. 2 and Plate 6, fig. A.

Cæspitosa erhizomatosa, radicibus fibrosis. Folia linearia 2–6 cm longa medio 1–1.5 mm lata flaccida lævia compressa apice longe acuminata tenuissime plurinerviæ margine minute asperula, vaginis ad 15 mm longis plicatis compressis plurinervosis inferme fuscis margine latiuscule tenuimembranaceis, ligulis vix evolutis. Pedunculi erecti graciles 6–12 cm alti læves vix compressi. Spica ovoidea vel globosoellipsoidea castaneofusca 5–8 mm longa 4–6 mm crassa spisse pluriflora. Bracteæ squamiformes spisse imbricatim dispositæ inferiores plerumque 2 steriles minores obovatoellipticæ vel ellipticæ 2.2–2.5 mm longæ herbaceæ fuscæ dorso tenuiter unicostatæ apice fulvæ et puncticulatæ margine nigræ, reliquæ florentes ellipticæ vel late obovatæ 3–3.5 mm longæ 1.8–2.5 mm latæ naviculares herbaceæ flavofuscæ medio obscure fuscæ praeter costam unicam tenuem obsolete binerviæ apice rotundæ et mucronatæ margine integræ, parte apicis fulva dense puncticulata indistincta. Sepala lateralia oblanceolata incurva 3 mm longa supra medium vix 1 mm lata flavofuscata apice mucronata margine hyalina, carina lævissima exalata. Capsula ellipsoidea maturitate atrobrunnea 2.5 mm longa. Semina minuta circiter ¼ mm longa obovoidea castanea multicostata.

ANNAM: Nhatrang (B. Hayata, May 12, 1921, n. 510!—holotypus in TI).

Note. The smooth keel of lateral sepal distinguishes this taxon from allied small-sized *Xyris*.

ERIOCAULACEÆ

1. ERIOCAULON ALPESTRE Hook. f. et Thoms.

Eriocaulon alpestre HOOK. f. et THOMS. ex Körnicke in Miquel, Ann. Mus. Bot. Lugd.-Batav. 3 (1867) 163; HOOK. f., Fl. Brit. Ind. 6 (1894) 578; RUHLAND in Engl., Pflanzenr. 4–30 (1903) 95, ex pte.!; LECOMTE, Fl. Génér. l'Indo-Chine 7 (1912) 10, *Plate 6, D.*

TONKIN: Tamdao (B. Hayata, sin. num.!)—India, China, Philippines.

Note. Having expected the occurence of the present species in Indo-China, Lecomte included this in his Flore générale de l'Indo-Chine, without any citation of extant specimen from Indo-China. This Hayata's record may be the first one based upon a real specimen. *E. alpestre* in Ruhland's sense is composed of two taxa in the present days, namely *E. alpestre* in his meaning includes *E. robustius*, a Japanese allied one. Examining *E. alpestre,* I, however, found that there was not very important difference between the above two entities, and I was inclined to place *E. robustius* in a varietal rank as Maximowicz did in his first publication of this taxon:

Eriocaulon alpestre HOOK. f. & THOMS. var. *alpestre* (Hook. f. & Thoms.)—*E. alpestre* HOOK. f. & THOMS. ex Körn. in Miq. l. c.

Var. *robustius* MAXIM. Diagn. Pl. Nov. As. 8 (1892) 25—*E. robustius* (Maxim.) MAKINO in Jap. Bot. Journ. 3 (1926) 26—Japan, Korea, Manchuria, Siberia.

Var. *nigrum* (Satake) T. KOYAMA, comb. nov.—*E. robustius* var. *nigrum* SATAKE in Jap. Bot. Journ. 27 (1952) 268—Japan.

2. ERIOCAULON AUSTRALE R. Brown.

Eriocaulon australe R. BROWN, Prodr. Fl. Nov. Holl. (1810) 254; RUHL. l. c. 66; LECOMTE, l. c. 8.

ANNAM: Dalat (B. Hayata, n. 99!)—China (Kwantung), Australia.

3. ERIOCAULON BUERGERIANUM Kornicke.

Eriocaulon Buergerianum KÖRNICKE in Miquel, Ann. Mus. Bot. Ludg. Batav. 3 (1867) 163; RUHL., l. c. 94; SATAKE in Nakai, Nov. Flor. Japon. 6 (1940) 51—*E. pachypetalum* HAYATA, Ic. Pl. Formos. 10 (1921) 52, *fig. 29.*

TONKIN: Chapa (B. Hayata, sin. num.!)—China, Formosa, Liukiu, Japan.

Note. New to Indo-China.

4. ERIOCAULON ECHINULATUM Mart.

Eriocaulon echinulatum MART. in Wall., Pl. As. Rar. 3 (1832) 29; RUHL., l. c. 106; H. LECOMTE, l. c. 14.

SIAM: Nakay (B. Hayata, sin. num.!)—Cochin-china, Cambodgia, Tonkin, Philippines, China (Kwantung), Burma.

Note. This is a very distinct species chiefly by awned bracts and 2 herbaceous scaly sepals ending in an awnlike tip. It is of great interest that an *Eriocaulon* which bears a very close

resemblance to this species has been reported from Kiushu, the southwestermost part of Japan, by Dr. Ohwi recently. Its name is *E. seticuspe.*

5. **ERIOCAULON HAYATANUM** T. Koyama, sp. nov. Plate 2, fig. 3 and Plate 5, fig. B.

Annuum. Caulis abbreviatus rectus turbinatus circ. 3 mm crassum in sicco foliis emortuis dense obtectus, radicibus robustiusculis, septis vix visibilis. Folia pluria rosulata divergentia vel recurva brevia 15–35 mm longa 1.7–3 mm lata crassiuscula glabra extrinsecus subenervia margine plus minus involuta basi minute areolata apice sensim attenuata breviter acuminata. Vaginæ pedunculorum basium cylindricæ 2.5–5 cm altæ 1–1.6 mm latæ glabræ tenuiter plurinervosæ pedunculum perlaxe circumdantes apice membranaceæ obtusiusculæ oblique sectæ. Pedunculi 1–4 recti 15–30 cm alti 0.6–1.3 mm crassi glabri pluricostati nitiduli. Capitula depresse globosa 6.5–10 mm in diametro 3.5–6 mm alta alba dense villosa; receptaculum convexum pilosum; bracteæ involucrantes 9–12 obovatoellipticæ vel late obovatæ 1.6–2.2 mm longæ circiter 1.3 mm latæ apice obtusissimæ rotundatæ. Bracteæ florum obovato-rhomboideæ 2.5 mm longæ fuscoglaucæ apice deltoideæ acutæ versus basin gradatim attenuatæ intus glabræ extra margine apicis dorsoque subdense albopuberulæ fuscoglaucæ, puberibus albis linearilanceolatis unicellutatis. Flores masculi et foeminei mixti. Flores masculi brevissime stipitati; sepala 3 libera linearioblonga 1.8–2 mm longa glaucoatra apice rotundata dense albopuberula; corolla albida quam calyx longiora tubulosa sursum ampliata apice trilobata, lobis valde inæqualibus centrale 1 reliquis multo longiore ac latiore 0.8–1.2 mm longo albo subtus glabro supra subdense villoso lateralibus 2 minoribus late ellipticis apice rotundis margine sparse puberulis; stamina 6 lobos minorem corollæ excedentibus, antheris globosis atris. Flores foeminei eo masculo paullo majores; sepala 3 libera obovata 1.7 mm longa navicularia glauca nitidula apice obtusa emarginata versus basin subsensim attenuata breviter stipitata, marginibus sursum dense albopubescentibus medio sparse pilosis, puberibus unicellulatis; petala 3 libera oblongo-oblanceolata alba plus minus spongiosa 2.3–2.6 mm longa basi subsensim attenuata stipitata margine apicis dorsoque dense albopubescentia apice rotundata glandula atra unica coronata intus sericeopilosa et sparse pubescentia, puberibus marginis et dorsi lineariclavatis plerumque unicellulatis, illis partis interioris linearibus bi- vel tri-cellulatis; ovarium globosum 3-loculare, stylo erecto longiusculo, stigmatibus 3.

ANNAM: Dalat (B. Hayata, June 4, 1921, n. 101!—holotypus in TI); ibid. (B. Hayata, n. 8!).

Note. This taxon is distinguishable from *E. collinum* by completely free sepals of male flowers, female sepals emarginate at apex and much longer sheaths at the base of peduncles.

6. **ERIOCAULON HOMOTEPALUM** T. Koyama, sp. nov. Plate 2, fig. 2 and Plate 5, fig. C.

Annuum parvum fere ecauliferum, radicibus fibrosis, septis extrinsecus non visibilibus. Folia linearia 2–4.5 cm longa 1.5–2 mm lata patentia glabra flaccida tenuia inferne conspicue fenestrata apice gradatim attenuata breviter acuminata. Vaginæ tubulosocylindricæ cum foliis fere æquialtæ 2–3.5 cm altæ 1–2 mm latæ pedunculum laxe circumdantes glabræ tenuiter plurinervulosæ apice albohyalinæ obtusiusculæ antice oblique sectæ. Pedunculi 1–6 inæqualiter erectopatentes 5–11 cm alti circ. ⅓ mm lati in sicco laeves non torti. Capitula parvula turbinatohemisphærica 2.5–4.5 mm. in diam. 1.6–2 (–2.3) mm alta stramineopallida; receptaculum glabrum interdum sparse breviter pilosum; bracteæ involucrantes usque 20 ovales vel obovatoellipticæ 1.5–1.8 mm longæ 1–1.3 mm latæ tenuiter membranaceæ subtranslucentes straminescentes apice late rotundæ. Flores masculi et fœminei mixti bracteas involucrantes parum superantes. Bracteæ florum illi involucrantem similes obovatæ 1.8–2 mm longæ hyalinæ pallidæ translucentes subenerviæ apice vere rotundæ infra medium subsensim attenuatæ glaberrimæ. Flores masculi præcipue centrales illo fœmineo paullo minores; calyx præter basim breviter connatam liber, sepalis 3 anguste oblanceolatis dilute glaucis hyalinis apice rotundatis paucipuberulis; corolla calyce fere æquilonga tubulosa flavida a medio versus apicem sensim ampliata apice leviter trilobata, lobis late rotundis margine minute peberulis apice glandula atra unica coronatis; stamina 6 lobos corollæ excedentia, antheris atris globosis. Flores fœminei brevissime stipitati 1.7–1.8 mm longi; sepala 3 libera linearioblanceolata ¾-petalo æguantia hyalina pallide flavida translucentia apice acutiuscula margine apicis paucipuberula intus breviter sericeopilosa; petala 3 libera anguste oblanceolata hyalina dilute flaventia translucentia apice rotundata et glandula atra unica coronata margine apicis paucipuberula intus breviter sericeopilosa, puberibus subulato-linearibus unicellulatia; ovarium depresse globosum 3-loculare, stylo brevi recto, stigmatibus 3 petalis non excedentibus. Semina fulva late ellipsoidea vix ⅔ mm longa, cellulis superficialibus longitudinaliter rectangulis.

ANNAM: Krong Pha (B. Hayata, June 23, 1921, n. 997!—holotypus in TI).

Note. This species more or less resembles Japanese *E. atrum* and its allies in its external appearance of vegetative parts, there has been no suggestion, however, that the two species are otherwise akin.

7. ERIOCAULON LEPIDUM T. Koyama, sp. nov. Plate 3.

Annuum. Caulis perbrevis obsoletus rectus, radicibus circ. 1 mm crassia in sicco transverse septatis. Folia cæspitosa multa linearia patentia 2–7 cm longa 2–3 mm lata crassiuscula obsolete plurinervosa margine incurva subtus minute fenestrata sursum gradatim attenuata apicem acutiusculum formantia. Vaginæ pedunculorum basium cylindricæ 7–11 cm longæ 1.5–1.8 mm latæ pedunculum perlaxe circumdantes ex toto fenestratæ apice albohyalinæ oblique fissæ. Pedunculi plures fere æquales 58–79 cm alti graciles circ. ½ mm carssi straminei vix torti 6–8 costati læves. Capitula vere globosa 5.5–7.5 mm in diametro 5–7 mm longa fuscoaurea; receptaculum longe sericeopilosum; bracteæ involucrantes plures (usque 24) obovatæ vel obovato-ellipticæ 2.6–3.2 mm longæ supra medium 1.5–1.8 mm latæ tenuimembranaceæ glaberrimæ plus minus nitentes medio fulvæ uminervatæ latere aureæ subtranslucentes apice subito angustatæ deltoideorotundatæ mucronatæ, basi sensim attenuatæ. Flores multi valde spissi masculi et fœminei mixti. Flores masculi præcipue centrales, squamis illi fœmineæ similis; calyx 2.5–2.7 mm longus, sepalis 3 liberis et basi tantum breviter connatis linearilanceolatis hyalinis supra medium nigrescentibus apice rotundis margine paucipuberulis, puberibus uni- (raro bi-) cellulatis longiuscule subulatis albis; corolla tubuloso-ochreiformis quam calyx paullo brevior hyalina pallida apice trilobata, lobis brevis ellipticis apice rotundis longiuscule puberulis; stamina 6, filamentis brevibus inæqualibus, antheris atris parvis globosis. Flores fœminei illo masculo breviores, bracteis oblanceolatis 3 mm longis supra medium fere 1 mm latis hyalinis fulvis dorso aureonigricantibus glaucofuscisve parce puberulis apice subito angustatis acutis basi cuneatoattenuatis; sepala 3 libera linearilanceolata hyalina vix 2 mm longa supra basin nigra margine partis superioris sparse puberula, puberibus unicellulatis subulatus; petala 3 libera linealioblonga 1.7 mm longa dilute fulva hyalina subtranslucentia apice rotundata eglanduligera margine apicis dense albopuberula basi cuneatoattenuata brevissime stipitata intus longe sericeopilosa; ovarium 3-loculare, stylo recto, stigmatibus 3. Semina ellipsoidea ½ mm longa olivaceofusca, cellulis superficialibus transverse hexagonalibus medio minute hamatis.

SIAM: Doi Step (B. Hayata, October 3, 1921, sin. num.!—holotypus in TI).

8. ERIOCAULON NAKAYENSE T. Koyama, sp. nov. Plate 2, fig. 1 and Plate 5, fig. A.

Annuum parvulum. Caulis non evolutus, radicibus fibrosis, septis valde inconspicuis et vix visibilibus. Folia brevia 6–14 divergentia rosulata lanceolata vel oblonga 6–20 (–25) mm longa 1–4 mm lata crassiuscula supra dense papillosa et asperula sed demum glabra et distincte fenestrata subtus glabra plurinervulosa a basi ad apicem utrinque subsensim angustata et in acumem breve producta. Vaginæ quam folium multo longiores graciliter cylindricæ 2–4.5 cm longæ ⅔–1 mm latæ pedunculum arcte circumdantes pluricostulatæ ex toto papillosæ apice tenuimembranaceæ oblique sectæ. Pedunculi graciles 1–4 (–6) fere æquialti 9–30 cm alti circiter ½ mm crassi (3–) 4 (–5)-costati glari plus minus torti. Capitula globosa 3–5 mm longa ac crassa nigrescens; receptaculum pilosum; bracteæ involucrantes usque 9 late obovatæ herbaceæ 1.5–1.8 mm longæ apice rotundæ extra sæpe sparse pubescentes intus glaucæ glabræ. Flores multi masculi et fœminei mixti; bracteæ florum late obovatæ subcoriaceæ 1.6–2 mm longæ naviculares apice abrupte angustatæ deltoideæ acutæ versus basin gradatim attenuatæ extra fulvoglaucæ superne dense albopuberulæ intus glabræ. Flores masculi centrales vix 1 mm longi; sepala 3 præter basem breviter connatam libera linearilanceolata nigrescentia apice rotundata margine sparse albopuberula; corolla alba tubulosoconnata apice paullo ampliata trilobata, lobis ellipticis margine dorsoque longiuscule puberulis, staminibus 6 lobos corollæ multo excedentibus, antheris globosis atris. Flores fœminei plures illo masculo majores; sepala 3 libera oblanceolato-oblonga ad 1.7 mm longa nigrescentia apice rotundata vel acutiuscula medio utroque paucipilosa margine apicis dorsoque densiuscule albopuberula, puberibus subulatis unicellulatis; petala 3 libera ovatodeltoidea 1.5–1.7 mm longa sursum subabrupte cuneato-angustata apice acutiuscula infra

medium subito contracta longe stipitata dorso paucipuberula margine a medio ad apicem usque subdense puberula intus longe sericeopilosa, puberibus linearibus longis albis 1-3 cellulatis; ovarium depresse globosum 3-loculare, stylo erecto brevi, stigmatibus 3 petalis excedentibus. Semina circiter ½ mm longa ex toto dense clavatopuberula, cellulis superficialibus transverse 6- vel 5-gonalibus interdum rectangulis.

SIAM: Nakay (B. Hayata, December 16, 1921, sin. num.!—holotypus in TI).

9. ERIOCAULON NIGRUM H. Lecomte.

Eriocaulon nigrum H. LECOMTE in Morot., Journ. de Bot. 21 (1908) 89, 107.

Var. *nigrum* (H. Lec.)—*E. kaikœnse* MASAMUNE in Trans. Nat. Hist. Soc. Formosa 33 (1943) 25, syn. nov.

ANNAM: Nhatrang (B. Hayata, sin. num.!)—Tonkin, China Hainan Is.).

Var. *fuscescens* T. Koyama var. nov.—A typo caule breviter evoluto, foliis latioribus, pedunculis gracilioribus, capitula floribusque pallide fuscescentibus non nigrescentibus præcipue distat.—Plate 6, fig. E.

ANNAM: Nhatrang (B. Hayata, sin. num!)

Note. Through the courtesy of Mr. Keng, I was able to examine the type specimen of Dr. Masamune's *E. kaikœnse* (Masamune & Fukuyama, 322!). According to original description published in the Transactions of the Natural History Society of Formosa, *E. kaikœnse* appears to be a smaller plant of *E. nigrum* reported from Tonkin. Our Annam plants are a little larger than Lecomte's specimen.

10. ERIOCAULON SIEBOLOTIANUM Sieb. et Zucc.

Eriocaulon Siebolotianum SIEB. et ZUCC. ex Steud., Syn. Pl. Gl. 2 (1855) 272; HOOK. f. FLOR., Brit. Ind. 6 (1896) 577; RUHL., l. c. 111, f. 15: A-G.; H. LEC., l. c. 13; SATAKE in Nakai, l. c. 20.

ANNAM: Nhatrang (B. Hayata, sin. num.!)—Tonkin, Cochin-china, Philippines, Formosa, Liukiu, China, Japan, Malaysia, Africa, India.

11. ERIOCAULON UBONENSE H. Lecomte.

Eriocaulon ubonense H. LECOMTE in Morot. Journ. Bot. 21 (1908) 89, 109 et Fl. Gén. l. c. 16.—*Plate 6, C.*

SIAM: Nakay (B. Hayata, sin. num.!)—Annam, Cambodgia.

Note. This is a large-sized fine *Eriocaulon* well characterized by flaccid thick leaves and large heads composed of dark gray

floral bracts and densely bearded white disk flowers. This taxon is known only from Indo-China and Thailand. We have very little taxonomical data on *Eriocaulon* from Thailand. Only two species are represented by herbaria from Thailand. They are the present species and *E. glabriflorum,* the latter one being first reported from Malay Peninsula by Ridley.

12. **ERIOCAULON XENOPODION** T. Koyama, sp. nov. Plate 4.

Perenne. Tuber obconicohemisphæricus vel depresse globosus rigidus brunneus fibris foliorum emortuorum laxe obtectum 15–25 (–30) mm crassus basi radices robustiusculis dilute fuscas eseptatas multa emittit. Folia pluria linearia erecta 8–53 cm longa 1.5–5 mm lata crassiuscula mollia tenuiter multinervosa lævissima interdum torta plana vel margine plus minus involuta apice gradatim attenuata acutiuscula. Vaginæ penduncolorum basium cylindricæ 6–14 cm altæ 1.5–3 mm latæ tenuiter multinervosæ læves pedunculum sublaxe circumdantes apice acutiusculæ albohylinæ oblique fissæ. Pedunculi 2- plures erecti foliis duplo triplove altiores teretes 40–85 cm alti ad 2 mm crassi in sicco læves pluricostati vix torti. Capitula macra hemisphærica 7–12 mm in diametro 5–7 mm alta alboglauca dense villosa; receptaculum convexum dense sericeopilosum; bracteæ involucrantes 13–20 obovatæ 2–3 mm longæ medio circiter 1.5 mm latæ herbaceæ glaberrimæ obsoletissime pluristriatæ apice vere rotundæ. Flores masculi et fœminei mixti. Flores musculi circiter 2.5 mm longi, bracteis illis florum fœminearum similibus sed minoribus et tenuioribus; sepala 2 (rarissime 3!) complete libera oblanceolata navicularia albida unicarinata doso apicis subdense villosa; corolla alba tubulosa calycem fere æquans versus apicem ampliata apice trilobata, lobis late ovalibus apice rotundatis margine villosis intus glandula atra unica coronatis; stamina 6 quam lobi corollæ breviora, antheris nigris globosis. Flores fœminei circ. 3 mm longi; bracteæ obovato-ovales 3–3.5 mm longæ supra medium 2.3 mm latæ dilute fuscescentes infra medium unicarinatæ versus apicem subito contractæ in acumen deltoideum breviter productæ dorso sparse brevipubescentes; sepala 2 anguste oblanceolata albida 3–3.2 mm longa apice rotundata superne dense villosa; petala 3 libera ovato-oblonga alba 3 mm longa apice rotunda et glandula atra unica coronata margine apicis dorsoque densiuscule albovillosa intus longe sericeopilosa ac puberula; ovarium ⅗ mm longa 3-loculare, stylo recto 1.4 mm longo, stigmatibus 3 brevibus.

SIAM: Nakay (B. Hayata, December 16, 1921, sin. num.!—holotypus in TI).

Note. This strange taxon is outwardly allied to *E. ubonense* by its heads. Seeing herbaria, I at first thought that the above sheets were mixture of some heads of *Eriocaulon* and vegetative parts of *Xyris*, so large and distinct tuber this species has.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Xyris adusta* T. Koyama
2. *Xyris maritima* T. Koyama, type specimens

PLATE 2

FIG. 1. *Eriocaulon nakayense* T. Koyama
2. *Eriocaulon homotepalum* T. Koyama
3. *Eriocaulon Hayatanum* T. Koyama, type specimens

PLATE 3. ERIOCAULON LEPIDUM T. KOYAMA

FIG. A. Habitat
B. Apex of sheath
C. Involucral bract
D. Floral bract
E. Pistillate sepal
F. Pistillate petal
G. Pistillate flower with sepals removed
H. A part of seed surface
I. Staminate flower (Ic. Orig.)

PLATE 4. ERIOCAULON XENOPODION T. KOYAMA

FIG. AA. Habit
B. A part of root
C. Apex of sheath
D. Involucral bract
E. Floral bract
F. Pistillate flower with sepals removed.
G. Pistillate sepal
H. Pistillate petal
I. Staminate flower (Ic. Orig.)

PLATE 5–6. FLORAL PARTS OF ERIOCAULON AND XYRIS

Eriocaulon:

FIG. 1. Involucral bract
2. Floral bract
3. Pistillate sepal
4. Pistillate flower without calyx
5. Staminate flower
6. A part of seed surface
11. Pistillate petal
12. Hair of protillate petal

Xyris:

FIG. 7. Bract
  8. Lateral sepal
  9. Capsule
  10. Seed

PLATE 5

FIG. A. *Eriocaulon nakayense* T. Koyama
  B. *Eriocaulon Hayatanum* T. Koyama
  C. *Eriocaulon homotepalum* T. Koyama

PLATE 6

FIG. A. *Xyris maritima* T. Koyama
  B. *Xyris Adustra* T. Koyama
  C. *Eriocaulon ubonensis* H. Lecomte
  D. *Eriocaulon Australe* R. Brown
  E. *Eriocaulon nigrum* Lecomte var. *fuscescens* T. Koyama

BOOKS

Books received from time to time by the Philippine Journal of Science are reviewed and acknowledged in this section.

Relativity for the Layman. A simplified account of the history, theory, and proofs of relativity. By James A. Coleman. New York, The William-Frederick Press, 1954. 131p. Price, $2.75.

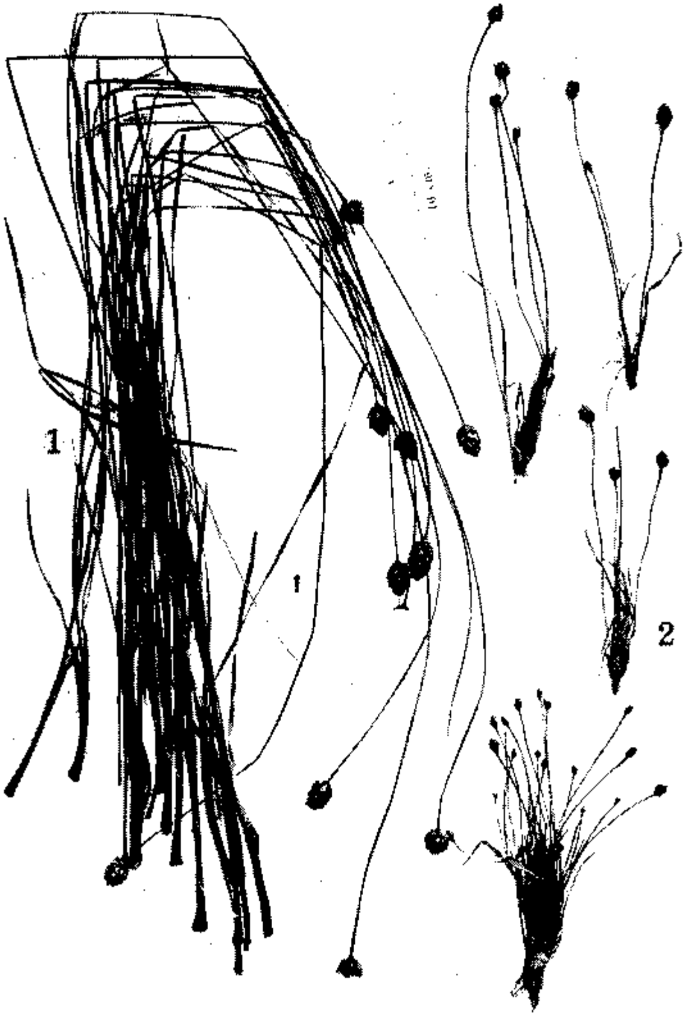
The theory of relativity since its inception by Einstein in 1905 has proved to be one of the greatest, if not the greatest scientific theory since Newton. One cannot lose sight of its far-reaching consequences as evidenced by developments in modern science and technology. The basis for the development of atomic bombs, which first startled the world in 1945, for example, can be traced to this fundamental theory.

The theory of relativity, however, is considered among people as very difficult to understand and for this reason many are discouraged to read books dealing on this subject matter. The present book under review, however, is indeed designed for the comprehension of the layman. The mathematical treatment presented in this book is reduced to the barest minimum, the language is simple and the ideas are accurate, in spite of the simplicity of presentation.

Since the nature of light, has a great deal to do with this great theory, the first part of the book is devoted to a clear historical exposition of the work done in connection with determination of the velocity of light. It describes in a very interesting manner the pioneering work of Galileo, as well as the more exact measurements made later by Michelson.

The latter part of the book is devoted to the various aspects of the relativity theory itself. The presentation of the theory is very informative and one gets the impression that he or she is actually conversing with the author. The conclusions that may be derived from the theory are illustrated in terms of common experience that are easy to grasp, but some are hard to believe, and still waiting for experimental verification.

—E. P. R.



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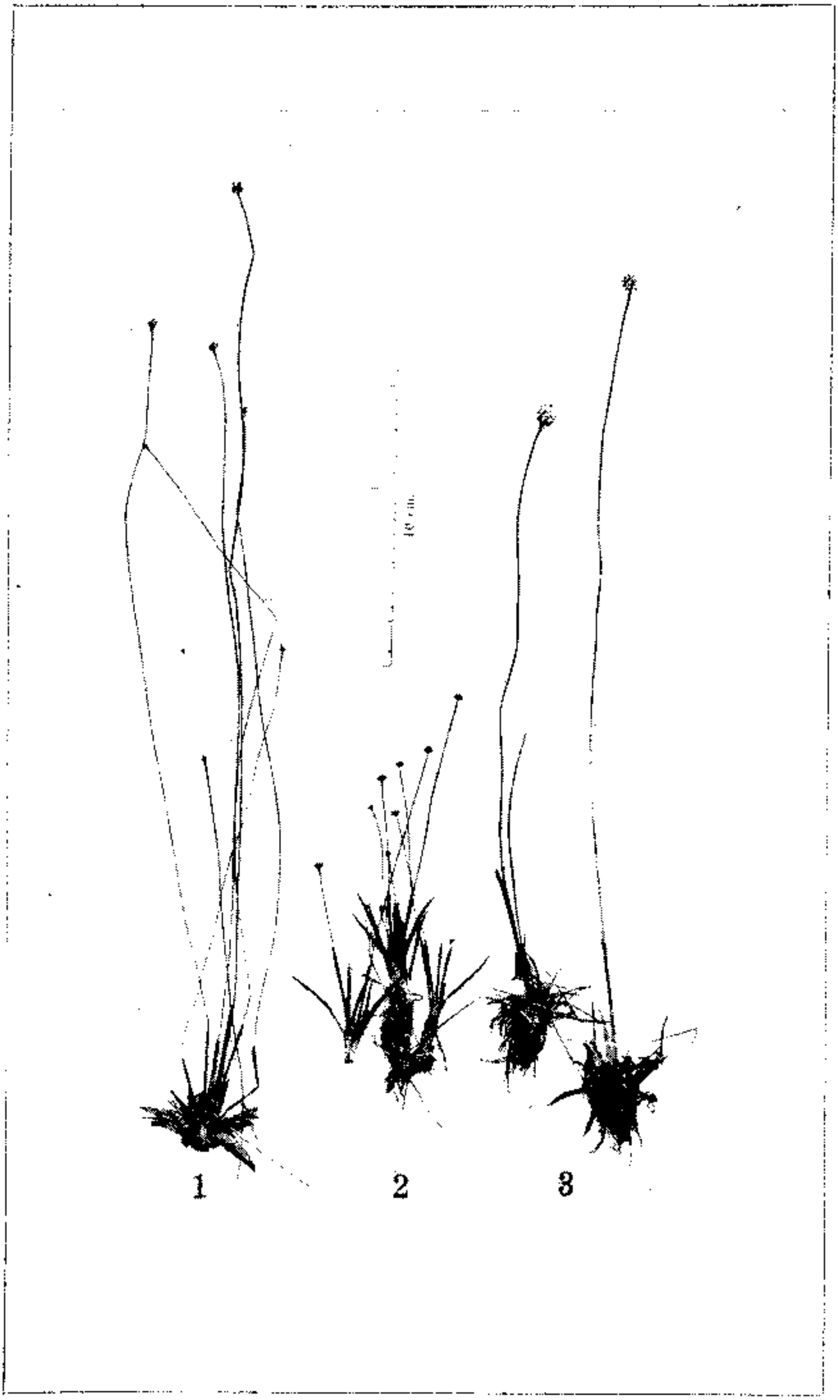

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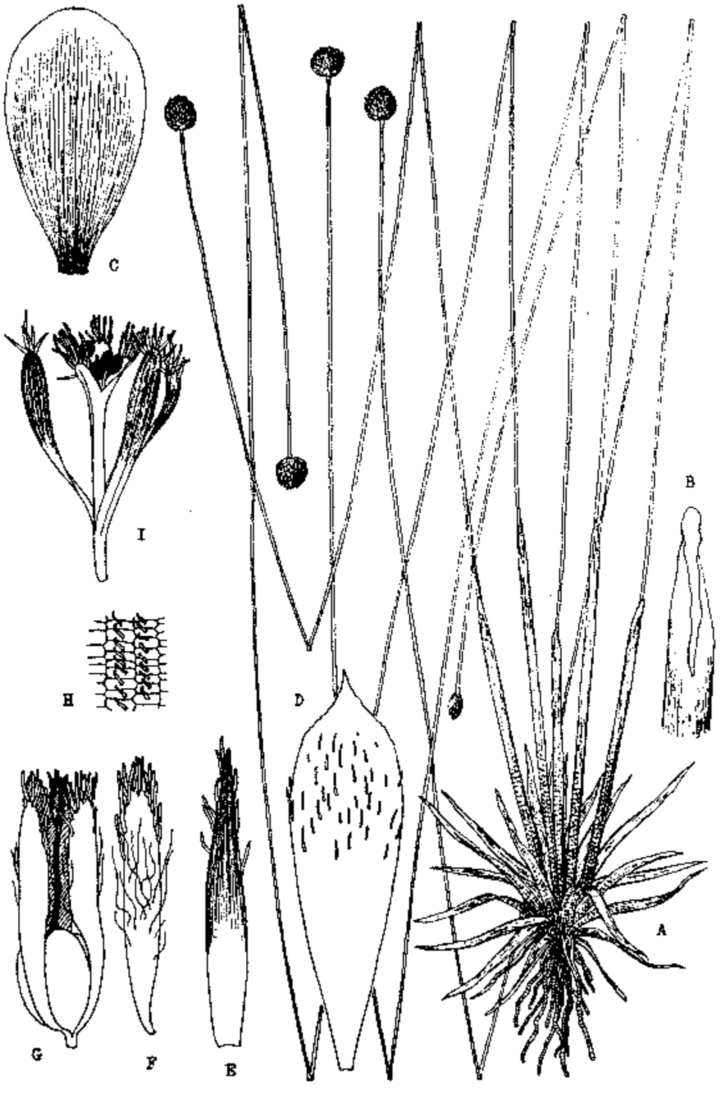

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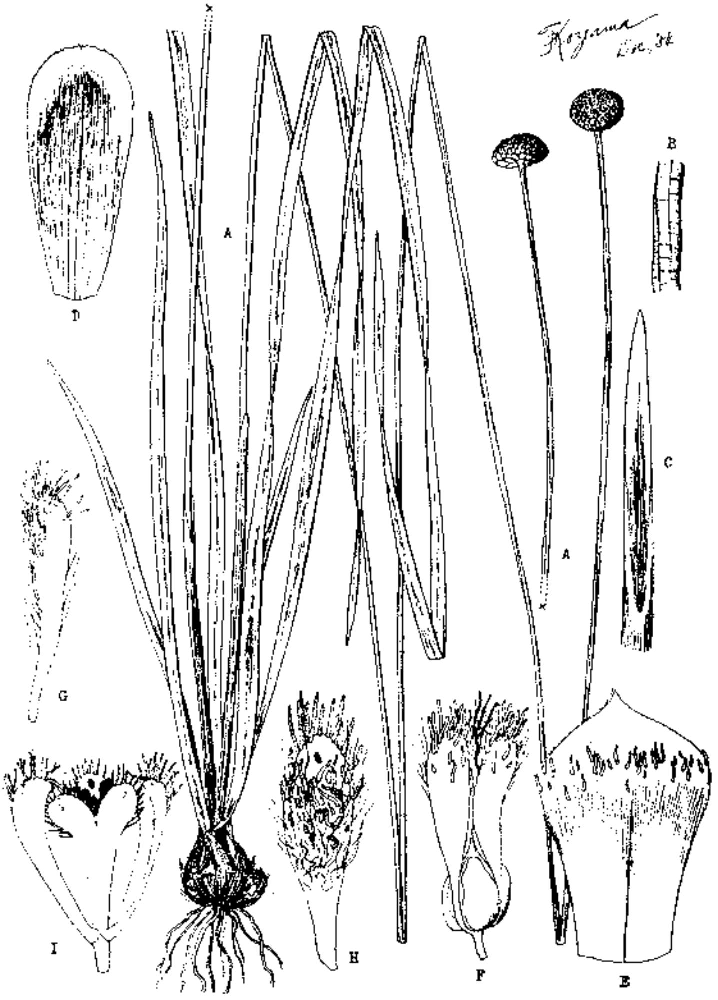

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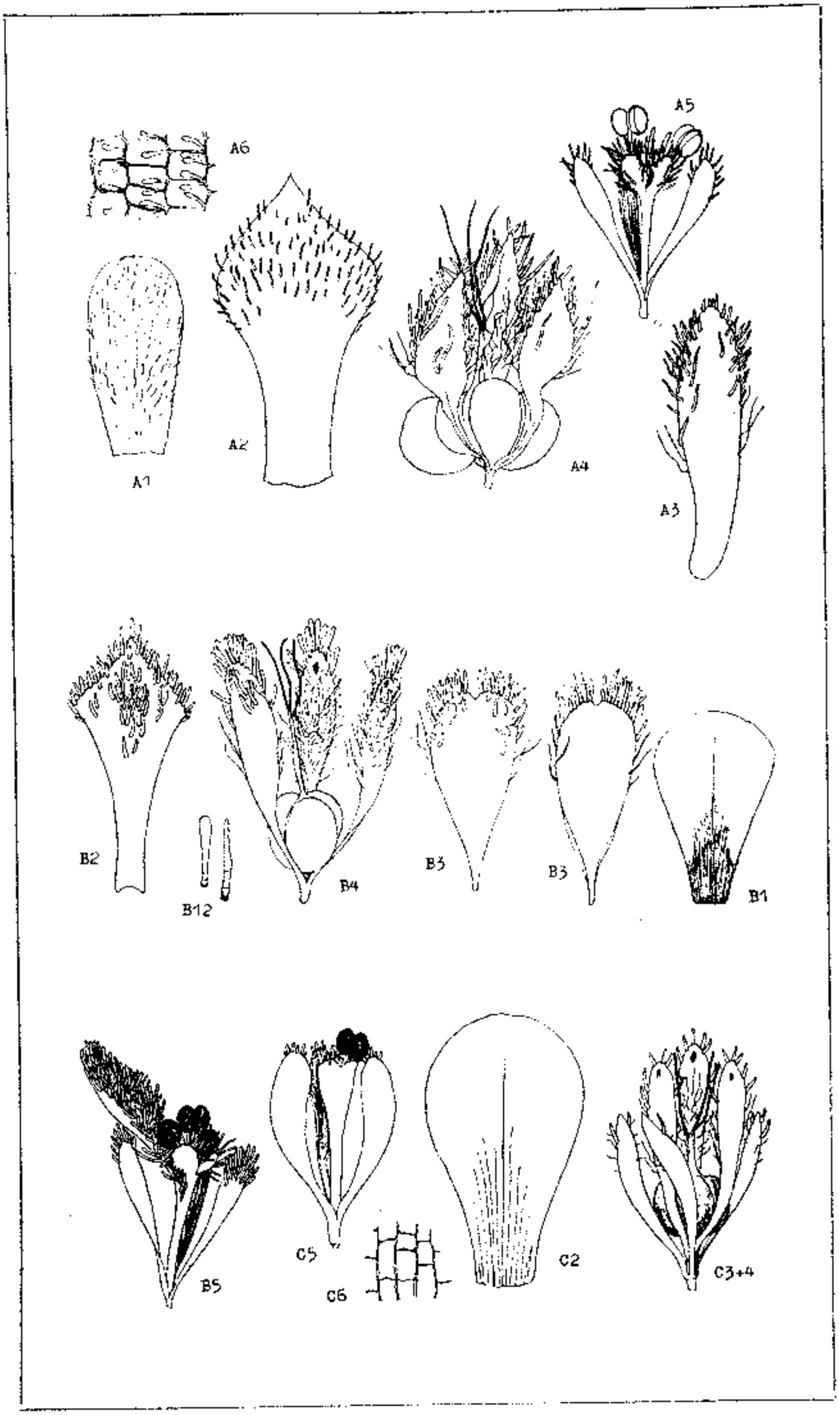

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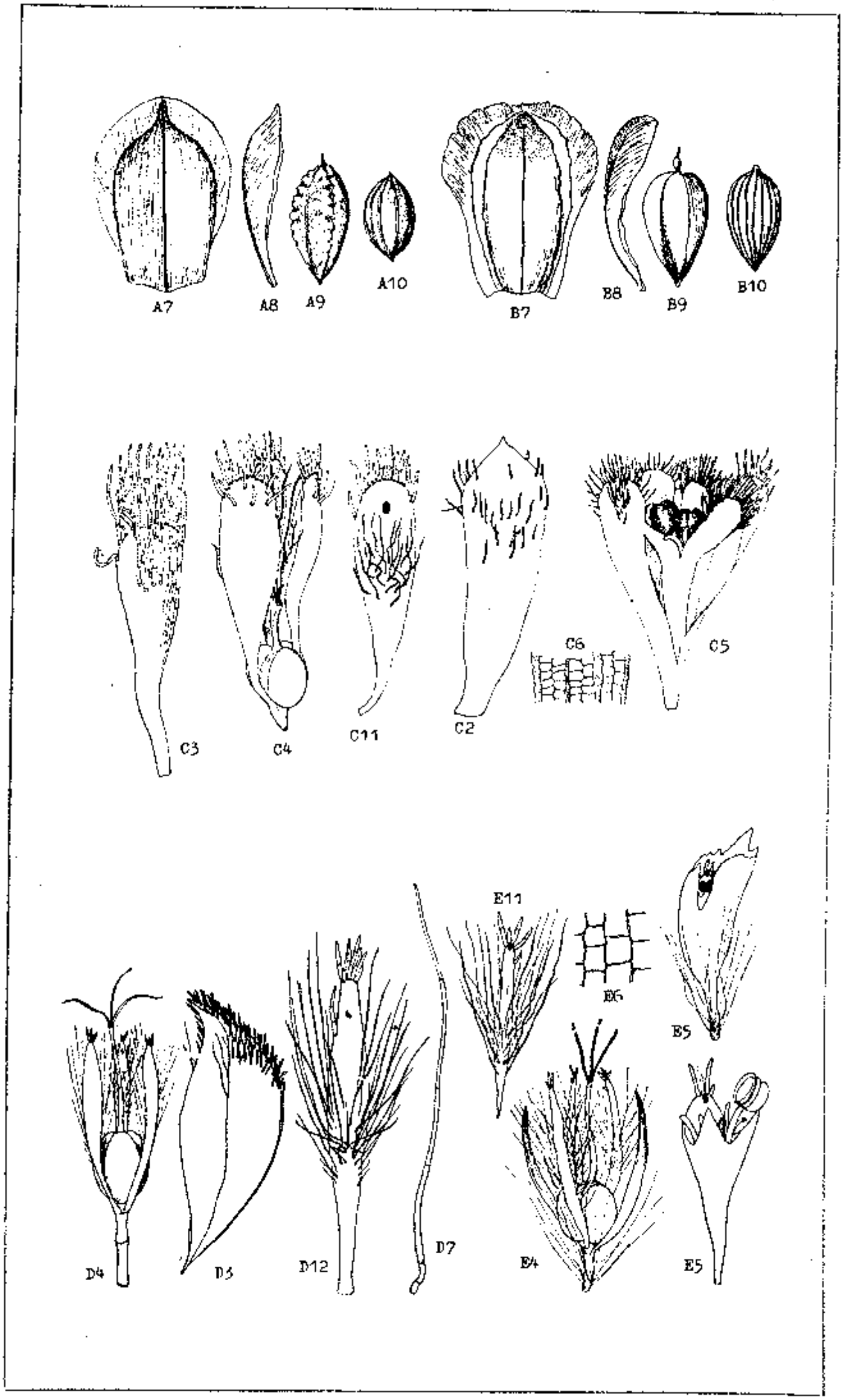
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D4
D5
D12
D7
E4
E5

PLATE 6.

PUBLICATIONS AVAILABLE

CONTENTS AND INDEX. THE PHILIPPINE JOURNAL OF SCIENCE, vol. 1 (1906) to vol. 10 (1915). Bureau of Science Publication No. 8 (1917). Paper, 442 pages. Price, $4.00 United States currency, postage extra.

SECOND TEN-YEAR INDEX. THE PHILIPPINE JOURNAL OF SCIENCE, vol. 11 (1916) to vol. 28 (1925). Compiled by Winifred I. Kelley. Bureau of Science Monograph 26. Paper, 382 pages. Price, $4.00 United States currency, postage extra.

CHECKLIST OF THE ANTS (HYMENOPTERA: FORMICIDÆ) OF ASIA. By J. W. Chapman and S. R. Capco. Institute of Science and Technology Monograph 1 (1951) new series. Paper, 327 pages. Price, $2.00 United States currency, postage extra.

NOTES ON PHILIPPINE MOSQUITOES, XVI. GENUS TRIPTEROIDES. By F. E. Baisas and Adela Ubaldo-Pagayon. Institute of Science and Technology Monograph 2 (1952) new series. Paper, 198 pages; with 23 plates and 4 text figures. Price, $2.50 United States currency, postage extra.

A REVISION OF THE INDO-MALAYAN FRESH-WATER FISH GENUS RASBORA. By Martin R. Brittan. Institute of Science and Technology Monograph 3 (1953) new series. Paper, 224 pages, with 3 plates and 52 text figures. Price, $2.50 United States currency, postage extra.

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